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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE ORIGIN OF HYPOTHESES, ILLUSTRATED BY THE DISCUSSION OF A TOPOGRAPHIC PROBLEM.**

AN important part—in some respects the most important part—of the work of science is the explanation of the facts of Nature. The process through which natural phenomena are explained is called the 'method of hypotheses,' and though it is familiar to most of my audience I shall nevertheless describe it briefly for the purpose of directing special attention to one of its factors.

The hypothesis has been called a 'scientific guess,' and unless the title 'guess' carries with it something of disrespect it is not inappropriate. When the investigator, having under consideration a fact or group of facts whose origin or cause is unknown, seeks to discover their origin, his first step is to make a guess. In other words, he frames a hypothesis or invents a tentative theory. Then he proceeds to test the hypothesis, and in planning a test he reasons in this way: If the phenomenon was really produced in the hypothetic manner, then it should possess, in addition to the features already observed, certain other specific features, and the discovery of these will serve to verify the hypothesis. Resuming

*Annual Address of the President of the Geological Society of Washington; read December 11, 1895, to the Scientific Societies of Washington. By special arrangement, through the Joint Commission of those societies, this number of SCIENCE is mailed to all members.

its examination, he searches for these particular features. If they are found the theory is supported; and in case the features thus predicted and discovered are numerous and varied, the theory is accepted as satisfactory. But if the reëxamination reveals features inconsistent with the tentative theory, the theory is thereby discredited, and the investigator proceeds to frame and test a new one. Thus, by a series of trials, inadequate explanations are one by one set aside, and eventually an explanation is discovered which satisfies all requirements.

When the subject of study is one of wide interest it usually happens that several investigators coöperate in the invention and testing of hypotheses. Often each investigator will originate a hypothesis, and a series of rigorous tests will be applied through the endeavor of each one to establish his own by overthrowing all others. The different theories are rivals competing for ascendancy, and their authors are also rivals, ambitious for the credit of discovery. The personal factor thus introduced tends to bias the judgment and is to that extent unfavorable to the progress of science; but the conflict of theories, leading, as it eventually must, to the survival of the fittest, is advantageous. Fortunately there is a mode of using hypotheses which regulates the personal factor without restricting the competition of theories, and this has found favor with the greatest investigators. It has recently been formulated and ably advocated by our fellow-member, Prof. T. C. Chamberlin, who calls it the 'method of multiple hypotheses.'*

In the application of this method the student of a group of phenomena, instead of inventing and testing hypotheses one at a time, devises at an early stage as many as possible, and then, treating them as rival claimants, assigns to himself the rôle of judge. Returning to the study of nature, he seeks for special features which cannot consist with all the hypotheses, and may therefore serve to discriminate among them. Thus by a series of crucial tests he eliminates one after another of the tentative theories until but a single one remains, and he then proceeds to apply such tests as he may to the survivor.

*The Method of Multiple Working Hypotheses, Science (1st series), Vol. XV. (1890) pp. 92–96.

In these methods of work, whether theories are examined successively or simultaneously, there are two steps involving the initiative of the investigator; he invents hypotheses and he invents tests for them. It is to the intellectual character of these inventions that your attention is invited.

The mental process by which hypotheses are suggested is obscure. Ordinarily they flash into consciousness without premonition, and it would be easy to ascribe them to a mysterious intuition or creative faculty; but this would contravene one of the broadest generalizations of modern psychology. Just as in the domain of matter nothing is created from nothing, just as in the domain of life there is no spontaneous generation, so in the domain of mind there are no ideas which do not owe their existence to antecedent ideas which stand in the relation of parent to child. It is only because our mental processes are largely conducted outside the field of consciousness that the lineage of ideas is difficult to trace.

To explain the origin of hypotheses I have a hypothesis to present,—not, indeed, as original, for it has been at least tacitly assumed by various writers on scientific method, but rather as worthy of more general attention and recognition. It is that hypotheses are always suggested through analogy. The unexplained phenomenon on which the student fixes his attention resembles in some of its features another phenomenon of which the explanation is known. Analogic reasoning suggests that the desired explanation is similar in character to the known, and this suggestion constitutes the production of a hypothesis.

To test this hypothesis of hypotheses I have for some years endeavored to analyze the methods employed by myself and some of my associates in geologic research, and this study has proved so interesting in connection with the investigation of a peculiar crater in Arizona, that I shall devote the remainder of my hour to an outline of that investigation.

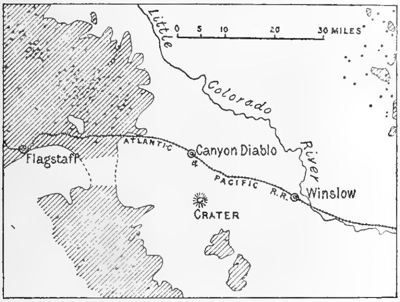

FIG. 1.—Map of part of northern Arizona. The shaded areas are covered by volcanic rocks. Dots mark ancient volcanic vents.

In northeastern Arizona there is an arid plain beneath whose scanty soil are level beds of limestone. At one point the plain is interrupted by a bowl-shaped or saucer-shaped hollow, a few thousand feet broad and a few hundred feet deep; and about this hollow is an approximately circular rim rising one or two hundred feet above the surface of the plain (Plate 1, Figs. 2 and 3). In other words, there is a crater; but the crater differs from the ordinary volcanic structure of that name in that it contains no volcanic rock. The circling sides of the bowl show limestone and sandstone, and the rim is wholly composed of these materials. On the slopes of this crater and on the plain round about many pieces of iron have been found, not iron ore, but the metal itself, and this substance is foreign to the limestone of the plain and to all other formations of the region.* The features of the locality thus include three things of unusual character and requiring explanation: First, the crater composed of non-volcanic rock; second, the scattered iron masses; third, the association of crater and iron. To account for these phenomena a number of theories have been suggested.

In the year 1886 a company of shepherds encamped on the slopes of the crater and pastured their sheep on the surrounding plain. Mathias Armijo, one of their number, found a piece of iron, and, deceived by its lustrous surface, supposed it to be silver. The mistake was quickly corrected by his fellows, but his discovery excited their interest, and other pieces of iron were soon found. The curiosity of the shepherds was aroused also by the crater, and they invented a theory which is admirable for its simplicity: The crater was produced by an explosion, the material of the rim being thrown out from the central cavity, and the iron was thrown out from the same cavity at the same time. You will observe that this theory is comprehensive. It accounts for the crater, the iron, and the association of the two. As I have never met these first students of the phenomena I have had no opportunity to make inquiry as to the origin of their theory; but its close relation to the theories of geologic disturbance which are current in mining districts suggests that it also sprung from the familiar process of blasting. As the firing of a blast opens a cavity and heaps dislocated rock masses in an irregular way, the unlearned miner finds in natural blasting an easy explanation of hollows and uplifts.

Four years later a man by the name of Craft saw in the iron a possibility of profit. Setting up a heap of stone to mark the spot,

* The crater is locally known as Coon Mountain, or Coon Butte. The iron is known to literature as the Canyon Diablo fall of meteorites.

he located a mining claim; and going to the city of Albuquerque, he announced that he had a vein of pure iron 40 yards wide and two miles long, and offered to sell his property to a railway company. The samples he submitted were examined by an assayer, and the officers of the company gave consideration to his proposal, agreeing to send a representative to examine the property. The negotiation was not concluded, because Mr. Craft, having borrowed money on the strength of his great expectations, mysteriously disappeared, but the incident served to give information of the locality to a scientific observer. The assayer forwarded a piece of the iron to the late Dr. A. E. Foote, the mineralogist, who visited the place, collected a quantity of the iron and examined the crater. In the summer of 1891 he communicated his observations to the American Association for the Advancement of Science,* which that year was the guest of the scientific societies of Washington, and his paper aroused much interest. For the crater of non-volcanic rock he offered no explanation, but the iron he pronounced of celestial origin—a shower of fallen meteors. It has long been known that many of the bodies which reach the earth from outer space are composed of iron, and that such iron is of peculiar character, having a certain crystalline structure, being alloyed with nickel, and including nodules of certain substances which are not found in any other association. So Doctor Foote, in characterizing the iron as meteoric, merely referred it to a well-established class. His explanation was not tentative, but final, and has not been called in question by any subsequent investigator.

In the discussion following the reading of his paper a new hypothesis was proposed, and as this was offered by myself I can trace its origin with comparative confidence. The crust of the earth is not equally dense at all points, but some parts are heavier than others. Not only are there variations from hill to hill and from formation to formation, but the continents are in general composed of lighter materials than the ocean beds, and one side of the sphere is so much heavier than the other that its attraction pulls most of the water away from the other side. Among the various theories that have been proposed for the origin of the planet there is one which ascribes it to the falling together under mutual attraction of many smaller celestial bodies, and it has been suggested that the variations in the crust may represent original differences of the concurrent masses. Speculating on such lines I had asked myself what would result if another small star should now be added to the earth, and one of the consequences which had occurred to me was the formation of a crater, the suggestion springing from the many familiar instances of craters formed by collision. A raindrop falling on soft ooze produces a miniature crater; so does a pebble thrown into a pool of pasty mud. A larger crater is made when a steel projectile is fired against steel armor plate; and analogy easily bridged the interval from the cannon ball to the asteroid. So when Dr. Foote described a limestone crater in association with iron masses from outer space, it at once occurred to me that the theme of my speculation might here find its realization. The suggested explanation assumes that the shower of falling iron masses included one larger than the rest, and that this greater mass, by the violence of its collision, produced the crater. Here again you will observe that a single theory explains the crater, the iron and their association.

The thought of examining the scar produced on the earth by the collision of a star

* A new locality for meteoric iron with a preliminary notice of the discovery of diamonds in the iron. Proc. Am. Ass. Adv. Science, Vol. 40, pp. 279–283.

was so attractive that I desired to visit the crater, but as that was not immediately practicable I arranged to have it visited by one of my colleagues. A few months later Mr. Willard D. Johnson spent several days at the locality, making a sketch map and describing the various features. When he reached the rim of the crater he found it to consist chiefly of limestone strata inclined outward, and his first thought was that the rim might be the remnant of the dome of strata over a laccolite. The laccolite is a peculiar volcanic product. The molten lavas which make volcanoes rise from deep sources through cracks or passages among the rocks and flow out over the surface of the land; but sometimes rising lavas fail to reach the surface, and accumulate at lower levels, opening for themselves bubble-shaped chambers over which the strata are arched. In the dome-like structures thus produced the rocks dip outward in all directions from a central region, and this outward dip was the feature which, through analogy, suggested to Mr. Johnson a laccolitic origin. His first idea, however, was not long retained, for examining the walls and bottom of the crater he found no trace of the igneous rocks of which laccolites are composed, and the theory afforded no aid in accounting for the hollow. He therefore dismissed it and sought another. He may have considered several others, but the only one placed on record is an explosion theory. In some way, probably by volcanic heat, a body of steam was produced at a depth of some hundreds or thousands of feet, and the explosion of this steam produced the crater. The fall of iron was independent, and the association of the two occurrences in the same locality is accidental.* As Mr. Johnson is at once a civil engineer and a student of geology and geography, he had at command as basis for analogic reasoning the explosive phenomena associated with the arts and also those which belong to the history of volcanoes, and we may assume that these suggested his theory.

* Mr. Johnson's discussion of the problem was communicated to me in a personal letter. G. K. G.

Mr. Johnson's account of the crater was much fuller than Dr. Foote's, but instead of satisfying my curiosity tended rather to whet it, and I availed myself of the first opportunity to make a personal visit. Four hypotheses had now been made, but only two survived. The theory of the shepherds, deriving the iron from the cavity of the crater, was disproved by Dr. Foote's determination of the meteoric character of the iron. The laccolitic theory had been promptly set aside by Mr. Johnson. There remained the theory of a star's collision and the theory of a steam explosion. If my visit was to aid in the determination of the problem of cause it must gather the data which would discriminate between these two theories, and an attempt was accordingly made to devise crucial tests. If the crater was produced by the collision and penetration of a stellar body that body now lay beneath the bowl, but not so if the crater resulted from explosion. Any observation which would determine the presence or absence of a buried star might therefore serve as a crucial test. Direct exploration by means of a shaft or drill hole could not be undertaken on account of the expense, but two indirect methods seemed feasible.

If the crater were produced by explosion the material contained in the rim, being identical with that removed from the hollow, is of equal amount; but if a star entered the hole the hole was partly filled thereby, and the remaining hollow must be less in volume than the rim. The presence or absence of the star might therefore be tested by measuring the cubic contents of the hollow and of the rim and comparing the two. Of the intellectual origin of this test perhaps the most that can be said is that it is a test by quantities, and that the experienced investigator, having previously found relations of quantity the most satisfactory criteria, habitually employs them whenever the circumstances permit.

Again it occurred to me that the stellar body would presumptively be composed, like the smaller masses round about, of iron, and that its presence or absence might, therefore, be determined by means of the magnetic needle. If it were absent the compass would point in the same direction, whatever its position with reference to the crater, whether within or without, on one side or the other, near by or miles away; but if a mass of iron large enough to produce the crater lay beneath it its attraction would pull the needle one way or the other, producing local variations. Doubtless the suggestion of this test came from knowledge of the methods employed in searching for magnetic iron ore in northern Michigan, where the prospector carries the dip needle to and fro through the forest, and by means of its changes of direction determines the position and extent of bodies of ore.

As an equipment for these measurements I provided myself with the instruments necessary to make an accurate topographic map, and obtained, through the courtesy of the Coast and Geodetic Survey, a full set of instruments for the observation of terrestrial magnetism. I was so fortunate, also, as to secure the coöperation of an expert magnetic observer, Mr. Marcus Baker, of the Geological Survey, and together we set out for Arizona.

At this time it seemed to me that the presumption was in favor of the theory ascribing the crater to a falling star, because that theory explained, while its rival did not, the close association of the crater with the shower of celestial iron. So far as we know, a falling meteor is just as likely to reach any one spot on the earth's surface as any other, and it is, therefore, entirely possible that the coincidence of the meteoric locality with the locality of the crater has no special significance; but if the two phenomena are not connected by a causal relation, it is no more probable that the crater should coincide in place with one of the 165 meteoric falls recorded within the bounds of the United States than that it should occupy any other spot of our broad domain. A rough estimate shows the probability of non-coincidence to be at least 800 times as great as the probability of coincidence. This by no means warrants the conclusion that an explanation ascribing a causal relation is 800 times as probable as one ascribing fortuitous coincidence, but it legitimately inclines the mind toward causality in the absence of more direct and authoritative evidence.

This point is illustrated by the investigation of the peculiar sky colors observed twelve years ago. Considering the phenomenon of coloration in its entirety—character, distribution and duration—it was not merely rare, it was unique. In the same year a tremendous volcanic explosion occurred in the Straits of Sunda, and that also was unique in intensity. The coincidence of the two, which in this case was a matter of time rather than place, led to the belief that the one was caused by the other, and this belief was held by many men of science before an adequate explanation of the mode of causation had been suggested.

So when Mr. Baker and I started for the crater it seemed rather probable than otherwise that we should find a local deflection of the magnetic needle, and that we should find the material of the rim more than sufficient to fill the hollow it surrounds.

Before our journey was ended another explanation suggested itself. Mr. Johnson had described the crater as not truly circular but somewhat oval, the longer diameter lying east and west. He noted also that

ILLUSTRATIONS TO ARTICLE BY G. K. GILBERT ON HYPOTHESES.

FIG. 1.—Lonar Lake, India, occupying an explosion crater. From Newbold's *Summary of the Geology of Southern India*, Jour. Roy. Asiatic Soc., vol. 9, p. 40. London, 1848.

FIG. 2.—The limestone crater of Arizona, Coon Butte, as seen from the south. Photograph of a model by Mr. Victor Mindeleff.

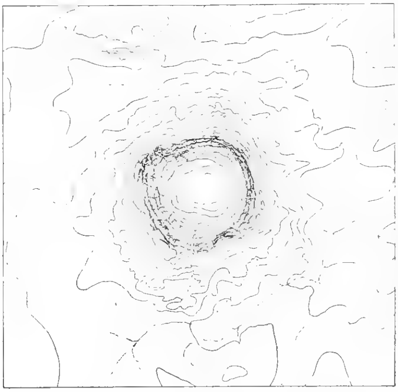

FIG. 3.—Contour map of Coon Butte. The vertical distance from contour to contour is ten feet. Lines of drainage are dotted.

FIG. 4.—Restoration of the site of Coon Butte before the formation of the crater. Contour interval, ten feet; lines of drainage dotted. Compare with Fig. 3.

FIG. 5.—Volcanic cinder-cone, with crater, north of San Francisco Mountain, Arizona. The position of the crater, at top of the hill, is characteristic of most volcanoes. Compare Fig. 2, where the crater lies chiefly below the level of the plain.

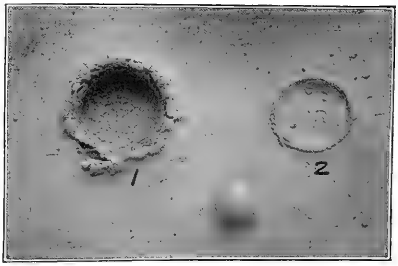

FIG. 6.—Craters made by throwing clay balls at a clay target. A ball of the same size is shown. 1 shows the effect of high velocity, 2 of low.

ILLUSTRATIONS TO ARTICLE BY G. K. GILBERT ON HYPOTHESES.

FIG. 1.—Rim of Coon Butte, with part of inner face.

FIG. 2.—Block of limestone on outer slope of Coon Butte, one-half mile from rim.

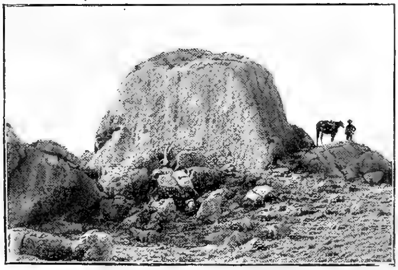

FIG. 3.—Largest block of limestone on rim of Coon Butte. Diameter, 60 feet.

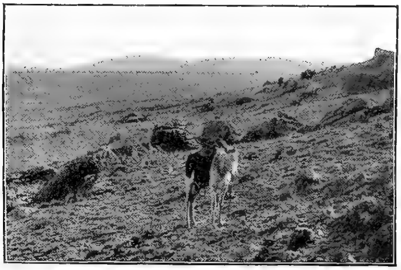

FIG. 4.—Outer slope of Coon Butte.

FIG. 5.—Interior of Coon Butte, as seen from the talus on one side. The cliff below the rim is of limestone.

FIG. 6.—Exterior of Coon Butte, as seen from the surrounding plain.

the rim was bulkier on the east side than on the west, and that nearly all the iron had been found east of the crater. The new explanation was that a star, falling obliquely from the western sky, struck the earth and bounded off, finally coming to rest at some point farther east. The idea was of course derived from the ricochet of projectiles; I had seen the mark left by a rifle ball where it rebounded from a plowed field. This explanation could be tested by a simple examination of the topographic form; and it may be as well to anticipate here the order of the narrative, and say that the form of the crater was found to be quite inconsistent with the ricochet hypothesis. The difference of the two diameters is quite small; the eastern rim is but little more massive than the western; and the dislocation of the rocks in the western rim is of such character that it could not have been produced by a body descending obliquely toward the east.

Arriving at the crater we spent two

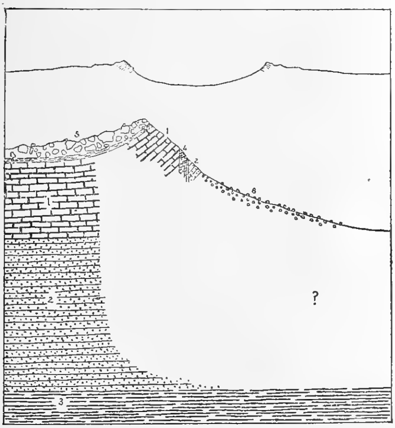

FIG. 2.—The upper diagram is profile across the crater; the lower, a cross-section of the rim. 1, limestone. 2, sandstone. 3, red shale. 4, crushed rock. 5, loose blocks of limestone and sandstone. 6, talus of debris fallen from 1 and 2 above.

weeks in topographic and magnetic surveys and the study of local details. The diameter of the bowl, measured from rim to rim, is about three-fourths of a mile. Its depth below the rim is from 550 to 600 feet; below the plain, 400 feet, the rim being 150 to 200 feet high. The rim is in part composed of limestone strata like those which underlie the plain, but turned up, so as to incline steeply away from the hollow on all sides. On the inclined strata rests a mantle of loose fragments which are in part of limestone and in part of sandstone. The limestone masses are fragments of the formation occurring just beneath, and the sandstone masses are fragments of a formation which underlies the limestone formation. Most of the masses are of moderate size, but others are large, the limestone reaching a diameter of 60 feet, and the sandstone about 100 feet. (Plate 2. Figs. 1–4.). They are irregularly mingled, one material predominating in one tract and the other in another. The limestone is the more conspicuous because withstanding better the attacks of the weather. In fact the larger blocks of sandstone have been so far washed away that they do not project above the surface. From the crest of the rim outward this loose material occupies the surface for an average distance of half a mile, being characterized by rolling or hummocky topography. At greater distances it is thinly spread and the constituent blocks are small. At one mile it is represented only by scattered fragments, but these continue with diminishing frequency to a distance of three and a half miles.

Inside the rim the edges of limestone strata occupy the slope for a space of 150 to 250 feet. They are succeeded in several places by sandstone strata, but the sandstone does not hold its original relation to the limestone; it is separated by a vertical zone of crushed rock, and there is other evidence that it has been faulted upward.

The lower slopes are occupied by fragments of limestone and sandstone with an arrangement showing that they have fallen from the cliff above so as to constitute a talus of the ordinary type, and the central tract is composed of fine material of the same kind. Whatever may have been the original shape of the pit, its present form has resulted from subsequent modification under the action of rain and frost.

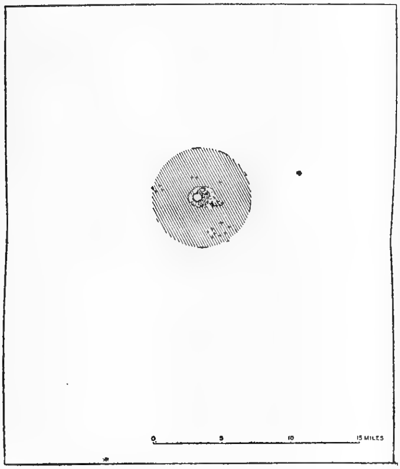

FIG. 3.—Distribution Chart. The inner line is the rim of crater. In the inner shaded area the loose debris has a depth of more than one foot. In the outer shaded area are scattered blocks; where the area is bounded by a line its limit was surveyed. The chief district of small iron masses is shown by dots. Large iron masses are indicated by crosses. The distribution of the iron is chiefly on the authority of Mr. F. W. Volz, of Canyon Diablo, A. T.

No iron has been found within the crater, but a great number of fragments were obtained from the outer slopes where they rested on the mantle of loose blocks. Many others were obtained from the plain within the region of scattered debris, and others, though a smaller number, from the outer plain. One large piece was discovered eight miles east of the crater, or almost twice as distant as any fragments of the ejected limestone. Another was long ago discovered twenty miles to the southward, but what became of it is not known, and it has not been definitely identified as a member of the same meteoric shower. Most of the masses are small. There have been found more than one thousand, possibly more than two thousand, pieces weighing less than an ounce; others weigh a few ounces or a few pounds; forty or fifty exceed one hundred pounds, and two exceed one thousand pounds. The total weight of all finds is probably ten tons. At the time of my visit I was told that all had been discovered east of a north and south line passing through the middle of the crater, but this may have been an accident of the method of search, for more recently six large ones have been reported from points west of that line.

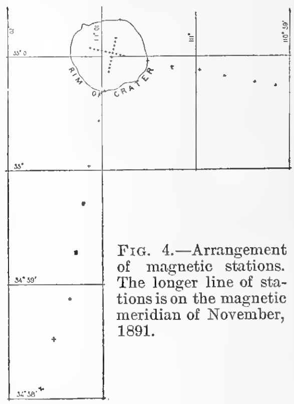

FIG. 4.—Arrangement of magnetic stations. The longer line of stations is on the magnetic meridian of November, 1891.

The magnetic survey by Mr. Baker included the selection and mapping of a system of stations, and the observation at each of the three magnetic elements: the horizontal component of direction, or the compass bearing; the vertical component of direction, or the inclination of the dip needle; and the intensity of the magnetic force. Two lines of stations, at right angles to each other, were carried across the crater, and one of these lines was extended to a distance of three and a half miles on the plain. When the results were tabulated and compared, the magnetism was found to be constant in direction and intensity at all the stations, the deviations from uniformity being not greater than the unavoidable errors of observation. So if the crater contains a mass of iron its attraction is too feeble to be detected by the instruments employed. That we might learn the precise meaning of this result, the delicacy of the instruments was afterward tested at the Washington Navy Yard, by observing their behavior when placed in certain definite relations to a group of iron cannon whose weight was known, and the following conclusions were reached: If a mass of iron equivalent to a sphere 1500 feet in diameter is buried beneath the crater it must lie at least 50 miles below the surface; if a mass 500 feet in diameter lies there its depth is not less than 10 miles. So the theory of a great iron meteor is negatived by the magnetic results, unless we may suppose either that the meteor was quite small as compared to the diameter of the crater, or that it penetrated to a very great depth.

The topographic survey was executed with such detail as to warrant the drawing of contour lines for each ten feet of height. (Plate 1, Fig. 3.) During its progress the configuration of the surrounding country was carefully studied, and its general plan was found to be so simple and regular that the original contours before the creation of the crater could be restored without great liability of error. (Plate 1, Fig. 4.) Such restoration was made, and with its aid two quantities were afterwards computed: first, the cubic contents of the rim so far as it projects above the ancient surface; second, the cubic contents of the hollow so far as it lies below the ancient surface. The two volumes were compared with each other and also with the volume of a spherical projectile estimated as competent to produce the crater. From experiments with balls of clay fired against a target of the same material it seems probable that a crater 4,000 feet in diameter might be produced by a swift-moving meteor with a diameter of 1,500 feet. (Plate 1, Fig. 6.) It seems possible, though not probable, that it could be made by a mass 750 feet in diameter. The volume of the greater assumed projectile is 60 million cubic yards; the volume of the lesser, 7½ million yards. The magnitude of the hollow was found to be 82 million yards, and the magnitude of the rim was also found to be 82 million yards. It, therefore, appears that if the rim were to be dug away down to the level of the ancient plain, and the material tightly packed within the hollow of the crater, it would suffice to precisely fill that hollow and restore the ancient plain. The excess of matter required by the theory of a buried star was not found.

Thus each of the two experiments whose testimony had been invoked declared against the theory of a colliding meteor; and the expectation founded on the high improbability of fortuitous coincidence nevertheless failed of realization.

Attention being now directed to the only surviving theory, that of steam explosion, all the various features discovered in the local study were considered with reference to it. To describe and discuss them on this occasion would lead too far from our subject, and they may be passed by with the remark that, while not all are as yet fully understood, they seem not to oppose the theory.

For the sake of applying another quantitative test, an attempt was made to ascertain whether the energy which could be developed by heating the water contained in the sandstone formation would be sufficient, when the overlying strata gave way, to hurl their fragments out upon the surrounding plain. As the data were quite indefinite the computation could result only in a rough approximation, and there is no need to weary you with its details, but it served to show that the assumed cause was of the same order of magnitude as the result accomplished. The idea of applying such a test needs no specific explanation, because quantitative tests of this particular type are among the most familiar resources of investigation. Whenever a tentative theory involves the application of force or the expenditure of energy the investigator (or his critic) habitually asks whether the assumed cause affords a sufficient amount of force or of energy.

Practically the same conclusion was reached in a more satisfactory way by studying the accounts of other natural explosions where steam was the agent. At several epochs in its history the top of Mount Vesuvius has been torn away by a sudden convulsion. In Java the summit of Mount Tomboro was blown away, with the production of a great crater which now contains a lake, and a similar catastrope occurred on the slope of Mount Pepandaján. The great explosion of Krakatoa, in 1883, demolished several volcanic islands and created others, reconstructing the topography of a district in the Straits of Sunda. On July 15, 1888, a great opening was torn in the Japanese mountain Kobandai, the summit and part of one side being removed. The last mentioned instance is the most available for comparison because the agency of steam distinctly appeared, and because the history of the event has been admirably reported by two Japanese geologists, Profs. Sekiya and Kikuchi, of Tokio. *

* The Eruption of Bandai-san. Trans. Seismological Soc. of Japan, Vol. XIII., (1890), pp. 139-222. 9 plates.

There were in this case about twenty explosions, all occurring within the space of one or two minutes. A cloud of rock fragments ascended to a height of 4,000 feet. The greater number, moving obliquely away from the mountain side, fell upon its lower slope, down which they rolled as an avalanche for a distance of five miles, overwhelming several villages and transforming a fertile plain into a rocky desert. In other directions fell showers of stones, and a cloud of dust descending more slowly. The resulting crater, less regular in form than the subject of our study, was nineteen times as capacious, and from its bottom fierce jets of steam issued for weeks and even months. Kobandai is a volcanic peak, and although it had been quiescent for ten centuries there can be little doubt that the steam it evolved was generated by volcanic heat.

The competency of volcanic steam for the production of a crater is thus shown by a parallel instance, and the only conspicuous difference between the Japanese case and the Arizonian lies in the fact that in the one the disrupted rock was volcanic and in the other it was not. This difference seems unessential, for in neither case was there an eruption of liquid rock; the ancient lavas of Kobandai had been cold for ages, and their relation to the catastrophe was wholly passive. Moreover, the manifestation of volcanic energy is no more exceptional on the Arizona plateau than in the Bandai district. The little limestone crater is in the midst of a great volcanic district. (Fig. 1, Page 3, and Plate 1, Fig. 5.) The nearest volcanic crater is but ten miles distant, and within a radius of fifty miles are hundreds of vents from which lava has issued during the later geologic periods.

In following this line of thought I have but reversed the logical route by which Mr. Johnson probably reached his theory, verifying the theory by recomparison with its source.

Yet other verification was afterwards found through the published accounts of certain small craters in Germany, France and India. In the valley of the Rhine are a number of circular basins, for the most part containing lakes and hence called *maars*. They are depressed below the level of the surrounding plain, and some of them are surrounded by raised rims. The descriptions are somewhat conflicting, but it is clear that some of the basins are hollowed chiefly from non-volcanic rocks, limestone, sandstone and slate, and that their rims are composed in part of fragments of similar rocks.* The Indian crater (Plate 1, Fig. 1), which also contains a lake, is hollowed from a volcanic rock, the Deccan trap, and shows no other material; but in other features it parallels so closely the Arizona crater that I quote from Doctor Blanford's description:

"The surrounding country for hundreds of miles consists entirely of Deccan trap; in this rock, at Lonar, there is a nearly circular hollow about 300 to 400 feet deep, and rather more than a mile in diameter, containing at the bottom a shallow lake of salt water without any outlet. * * * * The sides of the hollow to the north and northeast are absolutely level with the surrounding country, whilst in all other directions there is a raised rim, never exceeding 100 feet in height, and frequently only 40 or 50, composed of blocks of basalt, irregularly piled, and precisely similar to the rock exposed on the sides of the hollow. The dip of the surrounding traps is away from the hollow, but very low.

"It is impossible to ascribe this hollow to any other cause than volcanic explosion."†

* Volcanos. By G. Poulett Scrope. London, 1872. Pp. 369-384. Die Vulkane der Eifel, in ihrer Bildungsweise erlautert. By Dr. Herman Vogelsang. Naturkundige verhandelingen von der hollandische Maalschappij der Wetenschappen te Haarlem. Vol. 21, Part 1. Pp. 41-76.

†A Manual of the Geology of India, by H. B. Medlicott and W. T. Blanford. Part I., pp. 379-380 8vo. Calcutta, 1879.

For the sake of completeness, mention should be made of two other hypotheses, which resemble the laccolitic suggestion in that each was based on a single feature of the crater but failed to find verification in any other feature. The fact that the pit occurs in limestone suggested that it might be what is called a *limestone sink*, a cavern having been made by the solution of the rock and the roof having afterwards fallen in.* The fact that the loose debris of the rim lies in hummocks with intervening hollows, and thus resembles in its topographic character the terminal moraine of a glacier, suggested that ice was concerned in its distribution.

Yet another hypothesis, and the last that need be mentioned, was made by welding together two which had preceded. It is a general fact that causes are complex, and as the explanations which first suggest themselves are apt to be simple, it often occurs that the theory finally adopted combines elements of two or more of the theories tentatively proposed. The expert constructor of theories is therefore prone to suspect that rival explanations embody half truths, and to seek for methods of combination. The combination proposed in this case utilizes the theory of meteoric impact and the theory of volcanic explosion, and its author is Mr. Warren Upham. His suggestion is that, by some volcanic process, heat had been engendered among the rocks of the locality, so that the conditions were ripe for an explosion, and that the mine was actually fired by a falling star, whose collision ruptured a barrier between water and hot rock, or in some other way touched the volcanic button.† It will be noted that this explanation demands a coincidence of what may be called the second order, for the colliding star is supposed not only to have chanced upon the prepared

* This suggestion was made by a correspondent.

† American Geologist, Vol. 13, (1894), p. 116; also a personal letter.

locality, but to have arrived opportunely at the critical epoch.

Still another contribution to the subject, while it does not increase the number of hypotheses, is nevertheless important in that it tends to diminish the weight of the magnetic evidence and thus to reopen the question which Mr. Baker and I supposed we had settled. Our fellow-member, Mr. Edwin E. Howell, through whose hands much of the meteoric iron has passed,

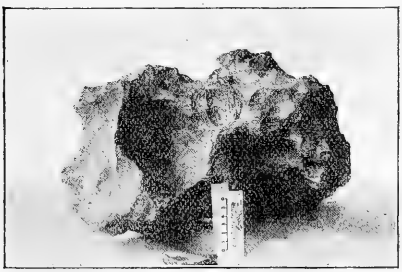

FIG. 5.—Iron meteorite found near the crater. Weighs 161½ pounds. Property of Mr. Edwin E. Howell, of Washington, D. C.

points out that each of the iron masses, great and small, is in itself a complete individual. They have none of the characters that would be found if they had been broken one from another, and yet, as they are all of one type and all reached the earth within a small district, it must be supposed that they were originally connected in some way. Reasoning by analogy from the characters of other meteoric bodies, he infers that the irons were all included in a large mass of some different material, either crystalline rock, such as constitutes the class of meteorites called 'stony,' or else a compound of iron and sulphur, similar to certain nodules discovered inside the iron masses when sawn in two. Neither of these materials is so enduring as the iron, and the fact that they are not now found on the plain does not prove their original absence. Moreover, the plain is strewn in the vicinity of the crater with bits of limonite, a mineral frequently produced by the action of air and water on iron sulphide, and this material is much more abundant than the iron. If it be true that the iron masses were thus imbedded, like plums, in an astral pudding, the hypothetic buried star might have great size and yet only small power to attract the magnetic needle. Mr. Howell also proposes a qualification of the test by volumes, suggesting that some of the rocks beneath the buried star might have been condensed by the shock so as to occupy less space.* These considerations are eminently pertinent to the study of the crater and will find appropriate place in any comprehensive discussion of its origin; but the fact which is peculiarly worthy of note at the present time is their ability to unsettle a conclusion that was beginning to feel itself secure. This illustrates the tentative nature, not only of the hypotheses of Science, but of what Science calls its results. The method of hypotheses, and that method is the method of Science, founds its explanations of Nature wholly on observed facts, and its results are ever subject to the limitations imposed by imperfect observation. However grand, however widely accepted, however useful its conclusion, none is so sure that it can not be called in question by a newly discovered fact. In the domain of the world's knowledge there is no infallibility.

And now let us return for a moment from the illustrative investigation to the hypothesis of hypotheses. If my idea is correct —if it be true that tentative explanations are always founded on accepted explanations of similar phenomena—then fertility of invention implies a wide and varied knowledge of the causes of things, and the

* Mr. Howell's suggestions were communicated orally and are here published by permission.

understanding of Nature in many of her varied aspects is an essential part of the intellectual equipment of the investigator. Moreover, mankind, collectively, through the agency of its men of science and inventors, is an investigator, slowly unravelling the complex of Nature and weaving from the disentangled thread the fabric of civilization. Its material, social and intellectual condition advances with the progress of its knowledge of natural laws and is wholly dependent thereon. As an investigator it makes each new conquest by the aid of possessions earlier acquired, and the breadth of its domain each day is the foundation and measure of its daily progress. Knowledge of Nature is an account at bank, where each dividend is added to the principal and the interest is ever compounded; and hence it is that human progress, founded on natural knowledge, advances with ever increasing speed.

G. K. GILBERT.

SOME FUNDAMENTALS OF NOMENCLATURE.

THE following paragraphs are a brief abstract of two consecutive papers read before the Biological Society, of Washington, on November 16 and 30, 1895. And, though averse to attempting the condensation of so much matter into small space, the attempt is made in deference to the expressed wishes of several who are interested in the questions discussed in the original papers.

It is certainly time that inquiry should be made into the remotest history of the evolution of the binary nomenclature in use by botanists and zoölogists; for it is only by the way of the history of any system that we may easily arrive at an understanding of its fundamental principles. Within the last thirty years there has been much legislation attempted respecting nomenclature. There is talk of further legislation in the future, and certainly much need of it, if by it we may hope to establish a rational and acceptable system. Yet very few of those who enter the arena of nomenclatorial discussion seem disposed to acquire anything more than a superficial knowledge of the origin and development of the binary system; they have never looked carefully to see whether priority, or fitness in names, or the mere convenience of the biological public at a given period, or prevailing usage, is the fundamental principle which has brought the system to its present state; or whether the combined force of all these and some other possible principles have given us such a system—or such a set of systems—as we have, and are more or less content, or discontented.

No subject is well understood, now-a-days, it is everywhere conceded, until it has been viewed from the evolutionary standpoint. But research into the history and evolution of our nomenclature is still neglected; and some are, I think vainly, hoping to resolve all difficulties even by burying still more deeply in oblivion the early history of nomenclature. This is really a curious point in the present status of things. But the present need of historical research is clearly evinced by the absurdities which legislative bodies have already given expression to when endeavoring to state fundamentals.

In attempting to set forth what it calls 'Leading Principles' even the celebrated 'Paris Code' is more remarkable for cheap platitudes and skillful evasions than for any distinct pronouncements regarding principles. Botanists of that period were beginning to awaken to a sense of the importance of priority, but were not yet ready to accord it a place among what were designated as the Leading Principles, yet placing it first among accessory, or secondary, elements of nomenclature.

The body of American botanists who, in 1892, promulgated what is known as the

Rochester Code took a much more decided stand in favor of priority, placing that very word itself foremost in their code. "Priority of publication is to be regarded as the fundamental principle of botanical nomenclature." This language is, nevertheless, not quite so positive as at first reading it might seem. This legislative body apparently wished to say that the principle of priority *is* fundamental, yet did not feel warranted in saying exactly that, but said instead 'is *to be regarded as* fundamental.' Here at once a rather serious question is suggested. Unless priority be quite clearly fundamental, why should a body of scientific men agree *to regard it as* fundamental? In code-making, of whatever sort, everything stands or falls with the ground truth or truths on which the several articles or statutes rest. Error as to the ground principle invalidates every rule and regulation that may be builded on it. Unless some one principle or set of principles may be declared quite positively fundamental, men waste their time in attempting to legislate; the rules are sure to be of little actual force. The authors of the Rochester Code, either consciously or unconsciously, were in a dilemma. They were obliged either to assert that priority is fundamental or else take for the ground principle of their code a mere hypothesis. They chose the hypothesis; and now, until they are ready to erase the hypothetic clause 'is to be regarded as,' each article which depends on the fundamentality of priority is equally hypothetical; that is to say, is no article at all, is utterly without force.

If priority were actually the fundamental principle of nomenclature it would be the chief criterion for the settling of the names of plants and animals; the oldest names would, as a rule, and without respect to other qualities, be maintained. This, however, is far from being the case, even under the working of the so-called Rochester Code. In the case of *Quercus Prinos*, for example, we are employing what is absolutely the latest of the several names that have been given that tree; while the name *Q. castaneæfolia*, which not only enjoys absolute priority, but is also the most appropriate name of all ever given to the tree, is not to be found even in the recent synonymy of the species, and few are aware of its existence; and very numerous instances of this kind could easily be adduced. It may be added, by way of further illustration, that for three centuries the common watercress was known in botanical works by one or the other of the two following names, *Nasturtium aquaticum* or *Sisymbrium aquaticum*. But Linnæus, whom so many people suppose to have been the founder of the binary nomenclature, rejected both these good binary names, disregarded priority, and assigned the species a new and a ternary name, *Sisymbrium Nasturtium aquaticum*. Then again, in 1810, two British botanists sought to reinvest the plant with a binary name; one of these, Sir John Hill, restoring the title *Nasturtium aquaticum*, which had so many centuries of priority in its favor; the other, Robert Brown, giving it still another new designation, *i. e.*, *Nasturtium officinale*, and yet this last, the most recent of all specific names for the cress, is the one which has been sustained everywhere until very recently. Priority certainly is not fundamental when men do again and again in practice so completely ignore it as to seem governed by the very opposite principle, that of taking the newest names instead of the oldest.

The language of the second article of the Rochester Botanical Code is, in several ways, most unfortunate. Its phraseology runs thus: "The botanical nomenclature of both genera and species is to begin with the publication of the first edition of Linnæus' Species Plantarum, in 1753." I do not wish to discuss the absurdity of naming, as initial for genera, a work in which no genus is defined by description, and in which few or none but the monotypical ones are defined even implicitly by the mention of type species; a book in which the generic names are, therefore, as a rule, *nomina nuda*. It is the unphilosophic handling of certain simple and universal principles, finding expression in logical absurdities, which most impresses the careful reader of the article above quoted. It is manifestly impossible that anything should be made to begin in time that is already past. Whatever affairs are to begin must begin either at once or in the future. Nothing 'is to begin,' or can be made to begin, last year or yesterday any more than in the year 1753. Doubtless the legislators at Rochester would have been glad had they dared to say that botanical nomenclature had its beginning in the year 1753. But they could not have said that. It would not have been true. They might, however, have offered an article which should have read somewhat after this fashion: "It is expedient that, in botanical nomenclature no priorities earlier than the year 1853 be recognized by us henceforward." I have little doubt that this is about what, from their point of view, they must have wished to say. But the situation, thus frankly expressed, would have been too manifestly an embarrassed one. Any number of persons might at once have asked: Why name as an initial date for genera and species a date which is not initial? Or, what expediency can there be in attempting to confine the action of the principle of priority—a principle whose sole force is retroactive—within such narrow limits? It would have been placing priority, previously agreed upon as at least hypothetically fundamental, under great restrictions such as utterly contradict the notion of its fundamentality. Priority is, above all other qualities in a name, the most absolute one, as absolute as the condition of time itself. Its only criteria are dates. If priority be fundamental in nomenclature, then there can be no such thing as an initial date later than the very first beginnings of botanical writing, or publication of names. But, of course, there must be an initial date, a date back of which priorities are to be disregarded; but if this be true, priority is not fundamental, at least not more fundamental than some other principles; very possibly less so. But, having resolved, as our code-makers did, to treat it as being the one ground-principle of the scientific naming of things, they are in a dilemma from the moment of having passed a regulation limiting its action to within what is really a very recent date in the history of nomenclature. The second article of our code, in its real meaning, if it have any, is an almost emphatic contradiction of the first article. It is practically little less than a nullifying of that declaration about the fundamentality of priority, for it excludes, according to credits as given by most learned and eminent botanists of all eras, more than two thousand years of indubitable name priorities, and admits no names as having a history of quite a hundred and fifty years.

The proposition, in itself so perfectly and so evidently true, that priority is determined simply by historic dates—a circumstance which no legislation can alter—brings us back to our initial suggestion, that we can never be prepared to discuss thoroughly the important question of nomenclature, much less be ready to legislate upon this matter rationally and effectually, until we have studied, historically, the evolution of our system of naming plants and animals.

Such historical inquiry would, I think, bring us quickly to the point of acknowledging the principle of convenience—of mere utility—to be the one fundamental thing, which, not only lies at the bottom, but also has chiefly ruled the development of such systems as we have. This, if found to be the fact, will be very far from yielding the least support to the people who just now, under the name of conservatism, are making the plea of convenience, as against us who would insist upon the exercise of the principle of priority ; for they are only pleading as against present changes, that is, against a present and transitory inconvenience, as affecting only the present generation of biologists; whereas, the only convenience which reasonable principles can very seriously regard and try to provide for must be the general convenience of all, that of the future as well as of the present; nay, more than of the present; because it would be absurd to question that the future generations of those who will have to do with the names—scientific names—of plants and animals, are prospectively a thousand fold more numerous and important a body than the whole little handful of to-day, how large a handful we to ourselves may seem.

Of convenience, one of the very prime conditions, as far as relates to nomenclature, is brevity. Such of the Linnæan names of plants and animals as are binary have, by universal consent, been allowed to supersede those older names which were of from three to a dozen words' length ; thus has more brevity abundantly proved itself a principle far more truly fundamental than priority.

Again, what is perhaps still more thoroughly an underlying principle of botanico-zoölogical nomenclature is that it be given in the terms of, and according to the rules of, an universal language. It were most easy to demonstrate that neither the binary quality of a name, nor a right of priority, nor both these qualities combined, ever gives a plant name the right to recognition, unless it have the quality of Latinity, unless it be given in the Latin language, at least as to its form. And this, too, is only a matter of general utility; convenience is looked to, not indeed of the English, or of the Germans, or of the Russians, or of the Japanese; for the botanists of each and all these nations, separately considered, would be better accommodated, the English by the adoption of English instead of Latin, the Germans by the adoption of German, as the language of scientific nomenclature, and so on through the whole list of modern tongues.

Under a rational treatment of the whole subject it can hardly fail to appear that, as making for the convenience of the whole botanical world, in time present and to come, the first fundamental principle is that of an Universal Language of Nomenclature; the second, that of Brevity in Names; the third—and this subservient to both the aforenamed, and secondary to them—the principal of Priority of Publication.

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Washington, D. C.

IMPRESSIONS OF THE NAPLES ZOÖLOGICAL STATION.

The *Stazione Zoologica* of Naples is so well known that it is quite unnecessary to say anything at present about the history of this famous establishment. The editor of Science has asked me, however, to write an account of the work of the station as seen from within during my visit of ten months to Naples. During that time it was my good fortune to occupy the table of the Smithsonian Institution, and I take this opportunity to express to the Secretary of the Smithsonian and to the Associated Board of Directors of the Naples Table my indebtedness for the appointment.

Prof. Dohrn has recently given in *Nature* an account of the history of the Naples station and of the work that has been accomplished. Prof. Dohrn's life and interests have been so intimately connected with the history of the Naples station, and his influence for good is so widely felt throughout the working of the institution that to speak of the success of the station is to speak of the splendid results of the life-work of one man. And all who have been in Naples will, I think, agree with me, when I add that to Professors Eisig and Meyer, no small part of the success of the station is also due.

The station is situated in the beautiful *Villa Nationale*, within a stone's throw of the Bay of Naples. The building of stucco and marble is in two parts joined by a bridge. Within are several well conducted departments. First is the aquarium proper on the ground floor of the larger building. This is open to the public. You enter a large square room with huge aquaria on the sides. In the center are still other and smaller aquaria. Each aquarium is built into the wall, and all the light comes from above, so that the observer standing within the darkened room sees the animals as though himself submerged amongst them. The effect is indescribably beautiful.

The aquaria are supplied with aerated, running water, and it is interesting to note that in winter when the turbid water of the bay is unfit for use, the water in the large reservoir in the station is used over and over again, even for months at a time.

A corps of fishermen is supported by the station and brings in every day fresh material to supply the wants of the investigators and to restock the aquaria. The other Neapolitan fishermen too have learned the value of the rarer animals, and a half-score of these interesting fellows are generally present in the collecting department bargaining, as only a Neapolitan can bargain, for their fish.

All of the Mediterranean forms of life are prepared by the station, and sold at very reasonable rates. Considering the skill required to preserve many of the delicate pelagic animals and the success of Sig. Lo Bianco in this direction, it is not surprising to learn that the Naples station supplies material to many of the largest museums and laboratories of the world.

The chief aim and work of the station is original investigation, and the laboratories are thoroughly equipped for this purpose. There are large zoölogical and physiological laboratories and a smaller botanical laboratory, and in addition a number of private rooms for special research. Each worker is fully equipped with the necessary reagents and apparatus. Peppino is always willing to add any special preservatives, etc., should such be needed. Each worker has a private aquarium for his own use. Every day there is brought in to him a fresh supply of animals.

So rich is the fauna of the bay and so well managed is the collecting department, with its little steamer and other boats, that you have only to make known your wants and you are often embarassed by the quantity of material that is brought to you. Even within the last year the equipment has been overhauled and greatly improved, so that the station is now better prepared than ever before to carry on its work. The number of investigators who go every year to the Naples station is the best guarantee of the widespread appreciation of its advantages. The library is excellent, and the books are made very accessible to all the workers in the station. In the arrangement of the books it is a model of what a library should be. Each investigator is allowed to go to the shelves and get his own books, leaving a card on the shelf in place of the book removed.

The laboratories are open day and night, and the rooms are heated in winter. This is by no means a small matter, for in winter the station is often the only warm place in Naples for weeks together.

The special advantages for work in Naples are I think, these: Absolute freedom to work on any subject desired, a plentiful and never-failing supply of fresh material and a well-filled library always at hand.

At the Naples station are found men of all nationalities. Investigators, professors, privatdocents, assistants and students come from Russia, Germany, Austria, Italy, Holland, England, Belgium, Switzerland and 'America'—men of all shades of thought and all sorts of training. The scene shifts from month to month like the turning of a kaleidoskope. No one can fail to be impressed and to learn much in the clash of thought and criticism that must be present where such divers elements come together. And through all the changes of life and thought Prof. Dohrn and his staff remain always open-minded, courteous, helpful and generous. Isolated, as we are in America, from much of the newer, current feeling, we are able at Naples, as in no other laboratory in the world, to get in touch with the best modern work.

During the ten months in which I was in Naples there were seven Americans there for longer or shorter periods. At present we have but one table under the direction of the Smithsonian Institution. It is needless to add that one table is insufficient for the demands of American students.

The following list gives the names of those who have occupied the Smithsonian Table: Mr. David Fairchild, of the United States Department of Agriculture; Prof. H. C. Bumpus, of Brown University; Prof. Wm. M. Wheeler, University of Chicago; Dr. Lewis Murbach, University of Michigan; Prof. Herbert Osborn, University of Iowa; Prof. T. H. Morgan, Bryn Mawr College; Mr. Walter T. Swingle, United States Department of Agriculture; Dr. J. M. McFarland, Leland Stanford University. The table has been continuously filled since its establishment, and more applications have been made than it was possible to grant.

Williams College at one time subscribed to a table for a year, and the University of Pennsylvania had also a table for a year; and more recently other Americans have enjoyed the advantages of a table subscribed for by Prof. Agassiz.

Major Davis has again and again in recent years most generously paid for tables for those who have been unable to find other opportunity, and it is notorious that for many years in the past the Americans in Naples have had to ask for foreign tables. It is to be hoped that a better time is coming.

T. H. Morgan.

Bryn Mawr College.

ANNUAL MEETING OF THE AMERICAN MATHEMATICAL SOCIETY.

The annual meeting of the American Mathematical Society was held in New York, on Friday afternoon, December 27, at three o'clock, the President, Dr. G. W. Hill, in the chair. Among those present were Prof. Ernest W. Brown, Prof. F. N. Cole, Dr. J. B. Chittenden, Prof. Edwin S. Crawley, Dr. J. W. Davis, Dr. W. S. Dennett, Mr. P. A. Lambert, Mr. G. Legras, Prof. A. Macfarlane, Mr. James Maclay, Mr. C. R. Mann, Dr. Emory McClintock, Prof. James McMahon, Prof. Mansfield Merriman, Prof. Hubert A. Newton, Mr. J. C. Pfister, Miss A. Rayson, Prof. J. K. Rees, Mr. R. A. Roberts, Prof. J. H. Van Amringe, Prof. J. M. Van Vleck, Prof. E. B. Van Vleck, Prof. R. S. Woodward. In the Secretary's report it was stated that the total membership of the Society was 267. The Council and Officers for the coming year are as follows: President, Dr. G. W. Hill; Vice-President, Prof. H. A. Newton; Secretary, Prof. F. N. Cole; Treasurer, Prof. R. S. Woodward; Librarian, Prof. Pomeroy Ladue; Committee of Publication, Prof. Thomas S. Fiske, Prof. Alexander Ziwet, Prof. Frank Morley; other members of the Council, Prof. Henry

B. Fine, Prof. E. Hastings Moore, Prof. Ormond Stone, Prof. Simon Newcomb, Prof. Charlotte Angas Scott, Prof. Henry S. White, Prof. E. W. Hyde, Prof. W. Woolsey Johnson. Prof. B. O. Peirce. The presidential address, delivered by Dr. Hill, was entitled: 'Remarks on the Progress of Celestial Mechanics Since the Middle of the Century.' It will be published in an early number of SCIENCE. Prof. James McMahon read a paper, entitled: 'Note on the separation of the velocity potential (expressed by functions of Laplace and Bessel) into two parts, representing an outward and an inward moving wave.'

THOMAS S. FISKE.

COLUMBIA COLLEGE.

CURRENT NOTES ON ANTHROPOLOGY

RESEARCHES IN SOUTH AMERICAN LANGUAGES.

FROM the rich field of South American linguistics several valuable products have lately been gleaned.

That deserving of the first mention is the narrative of a journey across the Cordillera from Chili eastward, recited in the Huilliche dialect of Araucanian. It was carefully taken down by Dr. Rodolfo Lenz and is printed in the 'Anales de la Universidad de Chile,' Tomo XC. The text, with a literal translation into Spanish, covers 22 pages, and is the first specimen we have, not only in this dialect but in Araucanian, proceeding from the unconstrained lips of a native. It is a model of the manner in which such a piece of work should be accomplished and presented.

The question of the Catamarcan language is again attacked by S. A. Lafone Quevedo in the Anales de la Sociedad Cientifica Argentina, Tom. XXXIX. in an article of 35 pages. He aims to demonstrate from proper names that it is not Kechuan in its affinities. His arguments are drawn from a full investigation of existing fragments of the tongue, and though not conclusive, make an able plea.

A careful vocabulary of the Guaná, from two independent sources, is published by the Reale Academia die Lincei (Rome), this year, the memoir being from the pen of the artist traveler, Guido Boggiani.

A short vocabulary of the Angagueda dialect of the Choco obtained in June last by Mr. H. G. Granger is edited with comparative words by me in the Proceedings of the American Philosophical Society for November.

To these must be added a valuable contribution on the language of the Akua (Chavantes, Cherentes), by Dr. Paul Ehrenreich in the Zeitschrift für Ethnologie, 1895, Heft IV: and several vocabularies from the Orinoco district, published by Dr. A. Ernst, of Caracas, in the American Anthropologist for October, 1895.

THE ANTHROPOLOGY OF WOMAN.

AT the August meeting of the German Society of Anthropology, at Cassel, the opening address was by Dr. Waldeyer, of Berlin, on 'the somatic differences of the two sexes.' Its aim was particularly to bring out the contrasts between woman and man, with the purpose of applying the results to the education and 'sphere' of woman. He argued that since a wide collation of measurements and statistics proves that she has a smaller brain, has less physical strength, preserves more traits of infancy and childhood in adult life, and has practically in all times and places held a position inferior to the man, that in our schemes of social improvement these undeniable facts should be respected. The efforts of social democrats and society leaders to establish entire equality between the two sexes and to throw open to woman all the avenues of activity enjoyed by man, he intimates, are mistaken, and will prove failures; and quotes with approval the opinion of Bartels, who maintains that the education, physical and mental, of woman, however high it may be, should be always aimed to fit her for the duties of the family circle only.

This conclusion will not be in the least acceptable to the 'advanced' women of the day, nor to those sociologists who see in woman's present condition, not the model of the future, but a survival from a barbaric past. D. G. Brinton.

SCIENTIFIC NOTES AND NEWS.

EXPERIMENT STATIONS FOR ENGINEERING.

A movement is in progress looking to the development at the 'land-grant colleges' of the several States, of a system of mechanical engineering 'experiment stations,' on much the same basis as the existing agricultural experiment stations organized under the Hatch bill of 1887. It is anticipated that the outcome will be the organization of such stations in all the agricultural and mechanical colleges of the country, in which the agricultural experiment stations have been successfully organized and operated. The purpose of the movement is to secure the promotion of engineering research, and of the development of the scientific facts and principles which are of most value to the mechanic arts and to the profession of engineering. The headquarters of the central office to which all will report is thought likely to be the Bureau of Steam Engineering of the Navy Department; that being the largest, most important and most generally suitable of the government bureaux to take cognizance of such work as is comtemplated. A Department of Mechanic Arts was proposed years ago, probably earlier than the Department of Agriculture, but the importance of the former has not been as promptly or as fully recognized as that of the latter, and nothing has yet been done in that direction. Should such a department be founded, it will naturally become the center of the work of mechanical engineering experiment stations. The present movement has its origin among Southern colleges, and members of the engineering profession who desire to see the encouragement of Southern industries through scientific method, and its earliest expressions is found in the papers of Prof. Aldrich of the West Virginia University, on engineering research.

THE BRITISH MUSEUM.

Natural Science states that the changes at the British Museum (Natural History) on the retirement of the Keeper of Zoölogy, Dr. A. Günther, are as follows: Prof. Sir W. Flower assumes the office of Keeper of Zoölogy in addition to his post as Director, without addition of salary; Dr. Bowdler Sharpe becomes Assistant Keeper of Vertebrata, his department consisting of Messrs. Thomas Boulenger, and Grant; Mr. Edgar A. Smith, Assistant Keeper of Invertebrata, associated with Prof. Jeffrey Bell, Mr. Pocock and Mr. Kirkpatrick; Dr. A. G. Butler, the head of the Entomological Department, with his juniors, Messrs. Waterhouse, Kirby, Gahan Heron, Austen, Hampson, and a new Assistant appointed to fill the vacancy. Mr. Pocock becomes a first-class Assistant. Changes have also been begun in the galleries. The larger fishes will be slung up to the roof, so as not to cumber the valuable floor space, and a more definite arrangement will be made of fishes; similar alterations are contemplated in the reptile gallery, where seventeen crocodiles have for many years enjoyed palatial quarters on the floor. The public gallery of birds will gradually be improved on the plan adopted already is one of the bays, and in the mammalian gallery certain arrangements are contemplated which will show the finer specimens to great advantage. The Trustees have recently purchased for the Department of Geology important series of fossils selected from the collections of the Rev. P. B. Brodie, Rowington, Warwick, and of the late Mr. James W. Davis, Chevinedge, Halifax. Mr. Brodie's collection includes a large number of type specimens described by various authors; and all of these are included in the British Museum selection except those in his unique cabinet of fossil insects, which he still retains. The collection of the late Mr. Davis contains some very fine fishes from the Lower Lias of Lyme Regis and a large number of fragmentary fish remains from the Yorkshire Coal-measures, described and figured in his own writings.

ASTRONOMICAL.

IN the *Astronomical Journal*, issued December 5th, Dr. Chandler publishes what we may call an ephemeris of the motion of the earth's pole, calculated for the years 1893 to 1896. This ephemeris is arranged in a form admirably adapted for the use of practical astronomers. The simple rectangular coördinates of the instantaneous pole are given for each date, so that it is possible to calculate the instantaneous latitude by means of the very simple formula :

$$\phi - \phi_0 = x \sin \lambda - y \cos \lambda$$

where λ is the longitude.

The numbers in Dr. Chandler's ephemeris are based upon his observational theory of the polar motion. Similar rectangular coördinates of the instantaneous pole, as obtained from actual modern observations, have been computed by Dr. Albrecht, of Potsdam, for the period from 1890.0 to 1895.3. Dr. Albrecht's results were laid before the International Geodetic Commission, which met at Berlin in September. They have not as yet been made generally accessible, though a few copies of his paper were prepared by a lithographic process for distribution among the persons specially interested.

PROF. MAX WOLF recently published in the *Astronomische Nachrichten* an interesting summary of his photographic minor planet work at Heidelberg during the years 1892 to 1895. The observations were made with a six-inch Voigtlaender lens. The total number of plates is 179, with exposures in some cases exceeding three hours. The number of planets found on the plates was as follows :

1892,	38 known planets,	18 new planets.
1893,	27 known planets,	9 new planets.
1894,	15 known planets,	6 new planets.
1895,	19 known planets,	3 new planets.

So it would almost seem that we are approaching the limit of discovery, for planets exceeding the 12th magnitude in brightness.

H. J.

GENERAL.

WE need in America a translation of the recently published work of M. Ch. Letourneau on *La Guerre dans les diverses races humaines.* War is said to have had its origin as a variety of hunting when food, other than human flesh, was unattainable, and when it was comparatively justifiable. M. Letourneau takes for his motto, as a definition of war: *Le vol pour but; le mentre pour moyen*—and he might have added, *la folie pour cause.*

IT is not always that a man during his lifetime learns in how high esteem he is held by those most competent to judge. Dr. Dawson may, therefore, not altogether regret the following editorial article in the *Journal of Geology*: "For the second time in the brief history of the *Journal of Geology*, we are called upon to record the loss of a member of its editorial staff. And now, as before, it is one in the prime of life, in the midst of a brilliant career, and in the enjoyment of rare prospects, Dr. George M. Dawson. Less than a year ago he was elevated to the directorship of the Geological Survey of Canada, a position which he had amply earned by a score or more years of markedly successful work on the Geology of the Dominion. His 'Geology and Resources of the 49th Parallel,' prepared when he was yet a very young man, gave him a recognized place in the scientific world. It has been followed by a long list of papers of unusual merit. It is to Dr. Dawson especially that we are indebted for the geology of the northern Cordilleras and the great northwestern plains beyond the national boundary. His studies lay along many lines, and the wide range of his abilities peculiarly fitted him for the multitude of questions that were presented in the exploration of his vast and varied field. We hope to present a more adequate notice of his work in a succeeding number."

PROF. LLOYD MORGAN, the English biologist, will lecture at Columbia on four Fridays in January, beginning January 10th. His subjects will be: 1. 'Illustrations of Instinct.' 2. 'Some Habits and Instincts of Young Birds.' 3. 'The Emotions in their Relation to Habit and Instinct.' 4. 'Some Instinctive Activities of the Pairing Season.' The lectures include a discussion of his own experiments and opinions upon the Darwin-Spencer theory of 'instincts as inherited habit.' His lectures before the

Lowell Institute in Boston will be delivered upon Tuesdays and Saturdays in January, beginning January 7th. He will also lecture at Brown University and at the University of Illinois. Letters addressed to the care of Columbia College or of the Lowell Institute will reach him.

THE one hundred and twenty-eighth Bulletin of the United States Geological Survey is a review of the Bear River formation and its characteristic fauna by Charles A. White. The author states that his object is the correction of an essential error which has long prevailed among geologists concerning the taxonomic position of one of the North American Cretaceous formations; that is, its object is to present a summary of the facts which show the entire separateness from the Laramie formation of that series of non-marine strata which has heretofore been known as the Bear River Laramie, with which formation the Bear River series of strata has long been confounded. To this end the Bear River series is defined as a distinct formation, stratigraphically, geographically and paleontologically, and its taxonomic position is stated in detail.

M. GEORGES LEMOINE reported to the Paris Academy on December 2 that he had measured the amount of decomposition caused by light in solutions of ferric chloride and oxalic acid, and had found the rate of decomposition to be approximately proportional to the intensity of the light. We are not informed how the intensity of the light was measured, but if the chemical action of light can be used to measure luminosity it would be an important photometric method. The photochemical and luminous intensity of light do not, however, remain proportional when the wave-length is altered.

IN a recent work on Meteorology in its relation to Hygiene, Dr. Van Bebbier states that the average total number of hours of sunshine per year is in England 1,400, in Germany 1,700, In Italy 2,300 and in Spain 3,000. In a hundred possible hours of sunshine there are in London on the average 23 and in Madrid 66.

AT a recent meeting of the Paris Academy MM. Troost and Ouvrard reported that they could only discover faint or doubtful traces of the spectrum lines of helium in sea water or in water from the Seine. It seems to follow that the helium in the mineral springs of Canterets cannot be attributed to the air, but comes from the rocks with which the water has been in contact.

DR. FAUVEL, born at Amiens in 1830, a specialist on diseases of the throat and nose and the author of important works on these subjects, died in Paris on December 17. On the same day the death occurred of Dr. Vandermey, professor of gynecology in the University of Amsterdam.

THE *British Medical Journal* states that Dr. A. J. Woïtoff, professor of bacteriology in the University of Moscow, recently fell a victim to his devotion to scientific research. He infected himself with a virulent culture while experimenting in his laboratory, and died soon afterwards of the effects of the accident.

THE life of Darwin, written by Prof. Wilhelm Preyer, has been published by Ernst Hofmann, Berlin.

'THE Earth's History,' by R. D. Roberts, of Cambridge University, and 'The Realm of Nature,' by Hugh B. Hill, are announced for publication by Charles Scribner's Sons.

IT is stated that the New York Pasteur Institute has purchased a farm of about 200 acres near Tuxedo Park to be used as an experiment station.

DR. D. MORRIS, Assistant Director of the Kew Gardens, delivered a lecture on 'The Rise and Progress of the Royal Botanical Garden at Kew, England,' at the American Museum of Natural History under the auspices of the New York Botanical Garden, on December 17th. Dr. Morris has now gone to the Bahama Islands, in order to investigate the cultivation of hemp and other products of the islands.

THE *British Medical Journal* summarizes in the issue of December 14th statistics which have been collected by Widmark regarding blindness in Scandanavia. These show that Denmark had in 1890 for every 10,000 inhabitants only 5.3 blind, Sweden 8.3, Norway 12.8, Finland 15.5. Compared to other European countries, of which Portugal and Russia stand highest with

20 blind for every 10,000, and Holland lowest with only 4.5, the order is as follows: Portugal, Russia, Finland, Spain, Norway, Hungary, England, Germany (without Prussia), France, Prussia, Sweden, Belgium, Austria, Switzerland, Italy, Denmark and Holland.

A SWISS National Exposition, promoted by the Swiss Confederation and the different cantons and cities, will be held at Geneva from May 1st to October 15th of the present year.

AT the 252d regular meeting, held Saturday, December 28th, the Biological Society of Washington elected the following officers for 1896: President, Surgeon General Geo. M. Sternberg; Vice-Presidents, Richard Rathburn, C. D. Walcott, L. O. Howard, B. E. Fernow; Recording Secretary, M. B. Waite; Corresponding Secretary, F. A. Lucas; Treasurer, F. H. Knowlton; Members of the Council, F. W. True, C. W. Stiles, W. H. Ashmead, F. V. Coville, C. L. Pollard.

THE New York *Evening Post* states that one of the greatest of the world's bridges is to be built at Detroit, to connect that city with Windsor. It is to be over two miles in length and to be five feet higher than the Brooklyn bridge. The plans for the structure have been prepared, and legislation looking to its construction has been asked in Washington and Ottawa. A corporation has been or will be organized under Michigan law to coöperate with a similar Canadian corporation in constructing the bridge, and the Vanderbilts will guarantee the bonds of both. The estimated cost is between four and six millions.

THE *Journal of Geology* announces that it will publish, beginning with the first number of Vol. IV., a series of four articles under the head of 'Studies for Students,' by Prof. Van Hise, on (1) Movements of Rocks under Deformation; (2) Analysis of Folds; (3) Cleavage and Fissility; (4) Joints and Faults.

THE *American Machinist* states that a bill has been introduced in the United States Senate by Senator Quay asking for an appropriation of $25,000 for the Franklin Institute and Purdue University, for the purpose of determining the quantity and effect of hammer blow, 'centrifugal lift and tangental throw' of locomotive wheels in use on American railroads; also the effects produced thereby.

THE *Appalachian Mountain Club* announces that it will publish in the early spring a 'Guide to Walks in the Country about Boston,' covering practically the ground embraced in the Club map of the country about Boston. The book will have many maps and be illustrated, and it is desired to have as many of these illustrations as possible taken by the amateur photographers of the Club.

UNIVERSITY AND EDUCATIONAL NEWS.

THE *Evening Post* states that at a meeting of the committee on buildings of the American University, architects have been chosen to prepare plans for the hall of the history building. A subcommittee was also chosen to take charge of the construction of the structure, which will cost about $150,000. Bishop Hurst announced an additional gift to the University, that of a business block in Findlay, Ohio, valued at $10,000, from John D. Flint, of Fall River, Mass.

MRS. T. K. W. SHIMER, owner and principal of the Mount Carroll Female Seminary of Mount Carroll, Ill., has offered to the University of Chicago the seminary buildings and twenty-five acres of ground, with an endowment of from $150,000 to $200,000, to be a girls' training school in connection with the University.

MR. SIDNEY A. REEVE, for several years employed with the engineering firm of Westinghouse, Church, Kerr & Co., and recently editorial writer on the *Progressive Age*, a journal devoted to gas interests, has been elected adjunct professor of steam and hydraulic engineering in the Worcester Polytechnic Institute. Prof. Reeve will begin his services in the Institute about January 1st, 1896.

MR. LECKY, the historian, has been elected member of Parliament for the University of Dublin by a majority of 750 votes.

DR. N. KUSNETZOFF has been elected associate professor of botany and director of the botanical gardens in the University of Dorpat.

A NEW educational review has appeared at Leipzig, *Deutsche Zeitschrift für Ausländisches Unterrichtswesen*, edited by Dr. J. Wychgram.

SCIENTIFIC LITERATURE.

Justus von Liebig, His Life and Work (1803–1873). By W. A. SHENSTONE, F. I. C., Lecturer on Chemistry in Clifton College. New York, Macmillan & Co. 1895. Pp. 220 + vi.

This is one of 'The Century Science Series' edited by Sir Henry Roscoe, and it is fitting that one of the first chemists to receive attention should be Liebig. In his preface the author says: "The name of Liebig is doubtless familiar to most of us, but I fear very few have any clear idea what he did, why chemists admire and esteem him, or, indeed, are aware that they do admire and esteem him. As the result of many inquiries made among cultivated people, I have found the prevailing impression concerning Liebig to be that he was a man who gained a large fortune by making 'extract of meat.' Now and then one meets someone who 'seems to have heard' of his name in connection with agriculture. Scarcely anyone now seems to know that he was one of the greatest of that class in whose work Mr. Balfour finds 'the causes which more than any others conduce to the movements of great civilized societies.' I have therefore made it my object in writing this little book not so much to dwell upon Liebig's private life as to tell what he was, what he did, and why all chemists and all those who are versed in the history of science admire and esteem him so greatly."

There can scarcely be a doubt that chemistry owes more to Liebig for its advancement during the present century than to any other one man. He was born in 1803 at Darmstadt, where his father dealt in colors, which he also manufactured. The boy was a failure at school. He had no ear memory and could not, therefore, make progress in linguistic studies. On the other hand, he had the powers of an experimenter, and was attracted by everything connected with chemical phenomena. He spent some time in an apothecary shop, but he took little interest in the commercial side of his occupation, and, in the course of a few months, he was sent back to his father. It was then decided that he should follow his bent and study chemistry. He went to the Universities of Bonn and Erlangen, but did not find what he wanted. In 1822 he took the degree of Doctor of Philosophy at Erlangen, and then he was provided with the means for continuing his studies abroad. He went to Paris and was soon admitted to the laboratory of Gay-Lussac, one of the leading chemists of that time. Two years later he was appointed Extraordinary Professor of Chemistry at Giessen. In 1826 he became full professor. In 1852 he was called to Munich, where he died April 18, 1873.

"Liebig was essentially a pioneer in science. In the course of his life he took the lead in no less than four great departures. The first was in organic chemistry, the second and third in the applications of chemistry to agriculture and to physiology, the fourth was the outcome of his labors as a teacher."

How he labored in these four fields is well told in Mr. Shenstone's little book, and every one interested in the intellectual development of mankind, be he chemist or not, will find here much that is stimulating and suggestive. The book is divided into nine chapters with the following titles: Introduction; Liebig and Wöhler; Chemical Discoveries; Liebig and Dumas; Fermentation; Chemistry and Agriculture; Physiological Chemistry; Education and Other Work; Character and Later Years.

Anleitung zur mikrochemischen Analyse der wichtigsten organischen Verbindungen. VON H. BEHRENS. Prof. an der Polytechnischen Schule in Delft. Erstes Heft (Anthracengruppe, Phenole, Chinone, Ketone, Aldehyde) Mit 49 Figuren im Text. Hamburg und Leipzig. Verlag von Leopold Voss. 1895. Pp. 64+viii.

The author of this book is well known in connection with work on microchemical analysis in general. He has now endeavored to show the chemist who deals with organic compounds how he may avail himself of the microscope for the purpose of recognizing various substances. The methods described have been thoroughly tested in the author's laboratory and the results have been most satisfactory.

The refinement attainable is not equal to that reached in the case of inorganic compounds. One cannot think of working with millionths of milligrams, and will at times have to be content if a satisfactory result is reached with tenths of milligrams. The classes of compounds dealt with, in this first number of the book, are: 1. The anthracene group; 2. Phenols; 3. Nitrocompounds; 4. Quinones, Ketones, Aldehydes. It is to be hoped that the appearance of the book will lead chemists to try the new methods, as it appears that their work will be much facilitated by them. It must, of course, be borne in mind that the problem of detecting minute quantities of organic compounds does not often present itself, though there are cases in which it becomes of importance. IRA REMSEN.

On the Densities of Oxygen and Hydrogen and on the Ratio of their Atomic Weights. By EDWARD W. MORLEY, Ph. D. Published by the Smithsonian Institution, Washington, D. C. 1895. 4°. xi. 117 pp.

For more than ten years Prof. Morley has been almost constantly engaged on the work which is described in this paper. With a painstaking fidelity to the highest ideals of accurate work which has rarely been equalled and has never been surpassed, he has determined four constants which are partly interdependent, and which are of very great importance in physical science. These constants are: the density of hydrogen, the density of oxygen, the ratio of the combining volumes and the ratio of the combining weights of the two elements.

The density of oxygen was determined by three different methods.

In the first series nine determinations were made. From nine to twenty-one and one-half liters of oxygen were weighed in large globes which were filled at the temperature of the laboratory.

In the second series sixteen determinations were made. Instead of measuring the temperature and pressure directly in this series the oxygen was brought to the same temperature and pressure as that of hydrogen contained in another large globe. The pressure of the hydrogen was previously measured at the temperature of melting ice, thus making the globe containing it, in effect, a very sensitive air thermometer. The difference between the coefficients of expansion of hydrogen and of oxygen was of course considered.

In the third series seventeen determinations were made. The globes were filled at the temperature of melting ice and, after weighing them filled with oxygen, they were exhausted and weighed again. The oxygen in this series was prepared partly from potassium chlorate and partly by the electrolysis of dilute sulphuric acid.

The results of three series were:

By use of thermometer and manometer	$D = 1.42879$
By compensation	$D = 1.42887$
By use of ice and barometer	$D = 1.42917$

Giving double weight to the last series, the weight of a liter of oxygen under normal conditions at sea level and in latitude 45° is 1.42900 grm., with a probable error of 0.000034 grm.

Five series of determinations of the density of hydrogen were made.

In the first and second series the same methods were used as in the first and third series for oxygen.

In the third, fourth and fifth series hydrogen was absorbed in palladium, contained in a glass tube, and, after weighing, was expelled into three globes which were surrounded with melting ice, and which had a combined capacity of forty-two liters. By this means three and seven-tenths grams of hydrogen were weighed in a comparatively small apparatus, and the volume occupied by the gas was accurately determined. The method has the additional advantage that any mercurial vapor contained in the globes was without effect on the determination. In all, sixty-four determinations were made. The results were as follows:

Series	I.	$D = 0.089938$
"	II.	$D = 0.089970$
"	III.	$D = 0.089886 \pm 0.0000049$
"	IV.	$D = 0.089880 \pm 0.0000088$
"	V.	$D = 0.089866 \pm 0.0000034$

It is believed that mercurial vapor entered the globes in the first two series and that the results of those series are too high. They are accordingly rejected. The remaining series give as the weight of a liter of hydrogen at sea level in latitude 45° and under normal conditions, 0.089873 ± 0.0000027.

In 1891 Prof. Morley published* a series of determinations of the volumetric composition of water. The results of these determinations were extremely concordant and there can be no reasonable doubt that the same ratio would be obtained again by the same method. When, however, this ratio is combined with the ratio of the densities given above, the resulting value for the atomic weight of oxygen does not agree with that which Prof. Morley has obtained by the direct weighing of oxygen and hydrogen and of the water formed by their union. Scott has recently determined† the volumetric ratio and finds the value 2.00285. This ratio, when combined with the ratio of densities as found either by Lord Rayleigh or by Prof. Morley, gives the same value for the atomic weight as that found by the gravimetric method. Prof. Morley has, therefore, determined the volumetric ratio by another method. In a series of ten experiments he determined the density of electrolytic gas obtained from a solution of caustic potash. He also determined the excess of hydrogen present in the gas. From the results obtained, and, taking into account the change in pressure occasioned when one volume of oxygen is mixed with two volumes of hydrogen and the mixture is made to occupy three volumes, the value 2.00269 for the volumetric ratio was calculated.

It seems to be established, therefore, that the values obtained by Prof. Morley with the eudiometer were not correct as representing the volumetric ratio and that the density of a gas in a tube is different from that in a globe, the effect on the density being different for a light gas from that for a heavy one.

The gravimetric composition of water was determined in a series of twelve experiments. In these the oxygen was weighed in large globes, the hydrogen (three and one-half grams), in palladium, and the two gases were burned in an apparatus so devised that the water formed was also weighed. In this way each experiment gave two independent determinations of the atomic weight of oxygen.

* Amer. Journ. of Science, *41*, 220.

† Phil. Trans. *184*, A, 543 (1893).

The results were:

From the ratio of hydrogen and oxygen,	15.8792
From the ratio of hydrogen and water,	15.8785

These values agree to the third decimal with the value calculated from the volumetric composition and the ratio of densities as given above.

The final results of Prof. Morley's determinations are:

	Grams.
Weight of one liter of oxygen, latitude 45°,	1.42900
Weight of one liter of hydrogen, latitude 45°,	0.089873
Atomic weight of oxygen, chemical method,	15.879
Atomic weight of oxygen, physical methods,	15.879
Molecular weight of water, chemical method,	17.879

In conclusion a summary of previous determinations of the constants in question is given. Omitting the earlier determinations, which were manifestly inaccurate, and the results of one more recent experimenter, whose work appears to have been affected by some source of constant error, the mean of all the other determinations of six different observers gives the value 15.879 for the atomic weight of oxygen.

It is impossible, in a brief sketch of this kind, to convey any adequate idea of the pains which was taken at every step to secure the greatest possible accuracy in the work, nor of the genius which has been displayed in devising complicated apparatus adapted for the determinations to be made. The work is classical and must, hereafter, be consulted by every one who wishes to do the best work in this field.

W. A. NOYES.

EIMER'S EVOLUTION OF BUTTERFLIES.*

PROF. EIMER, of Tübingen, is an enthusiastic opponent of Darwin's theory of Natural Selection, and has a theory of his own to replace it. The theory of Eimer has been defended by him on various occasions, his main exposition being given in his work on the origin of species published in 1888. His investigations on butterflies (thus far of the genus Papilio *auct.* only) are intended to afford proof of his theory in a

* Die Artbildung und Verwandtschaft bei den Schmetterlingen. II. Theil. von Dr. G. H. Theodor Eimer unter Mitwirkung von K. Fickert. Text 8vo. Pp. viii, 153. Atlas Folio Tafeln v.–viii. Jena, Gustav Fischer. 1895.

special case. His standpoint is indicated in his preface, in which he says:

"My butterflies demonstrate, as said above, the impotence of natural selection over a wide territory; their formation of species occurs evidently without any influence of Darwinian selection, and, therefore, disproves Darwinism completely. * * * * *There is no origin of species by natural selection*, but only a preservation of species already existing. The assumption that natural selection can bring forth new species rests upon a gross defect of reasoning (Denkfehler). Natural selection cannot cause new species to arise, either by the formation of new characteristics or by the division of existing chains of organisms into species. My butterflies show, in complete contradiction to the Darwinian doctrine, that new characters arise by development in a few predetermined directions (*Orthogenesis*) or by organic growth (*Organophysis*) from physiological causes. They show that it is essentially a still stand (*Genepistase*) at determinate stages of development, which separates a chain of organisms into species, together with certain other causes, such as the preventing of impregnation (*Kyesamechanie*) and development by jumps (*Halamatogenesis*)." *

He also claims that he presents only facts—no suppositions or hypotheses:

If Prof. Eimer's claims are correct, his researches mark one of the great epochs of biological discovery. It is, therefore, desirable to determine with precision the nature and value of the evidence which he presents.

The study of his work on butterflies (including both the present second part and also the first, published in 1889) shows that the facts of actual observation are solely the markings and geographical distribution of species of the genus Papilio *auctorum*. From these observations our author has deduced a systematic arrangement of several groups of species, so as to present them in what he believes to be their true phylogenetic relationships. From the standpoint of the systematic entomologist Eimer's work is certainly both interesting and valuable, since the figures and descriptions are very painstaking, and his groups are natural ones, and we may even go further and admit that his grouping of the species is in the main correct. Herewith we come, not without some surprise after the assurances of the preface, to the end of Eimer's positive facts. The remainder of his book is constructed of interpretations of the facts, and these interpretations cannot be designated otherwise than as a series of unproven assumptions and hypotheses. We may indicate the reasons for this characterization by a few illustrations of his reasoning. Thus he states (pt. i, p. 2) that in all animals longitudinal stripes are primary markings, longitudinal rows of spots secondary, and transverse markings tertiary. By this rule he is able to decide easily which living species of Papilio are nearest the ancestral forms. Surely such a universal rule needs to be demonstrated, not proclaimed *ex-cathedra*. His laws of the genesis of species are deduced thus: In a series of species of Papilio there may be ancestral forms with much black and descendent forms with little (Antiphates group), or just the other way the descendants blacker than the ancestors (Leosthenes-Ajax group) yet all the species concerned are living and no *proof* is offered that this or that form is ancestral, we are simply told that it is so. Again he finds a series of species, which differ from one another by the width of certain dark bands, each species taking its place according to the width of the bands. Such a series is his proof of *halmatogenesis*, and he entirely passes by the possibility that there may have been intermediate forms with the simple denial of their existence. Now it is certainly possible that the species of Papilio arise by discontinuous variation, to use Bateson's felicitious term, but between what seems possible in the present state of our knowledge, and absolute certainty there is a vast abyss, across which Prof. Eimer airily makes his way with the bare affirmation 'my butterflies prove halmatogenesis.' Not a word throws any light on the question how do they prove it?

Prof. Eimer lays stress upon the direction of the assumed development of a series of forms, and from the fact that a series of species may exhibit progressive increase in a certain character, he infers that the progress is a predetermined development. He overlooks this simple consideration *that no matter how evolution is caused it must be in some direction, and the mere observation of that direction cannot prove that there was a predetermining tendency to the ances-*

* Slightly abbreviated. The italics are the author's.

tral form to develop in that direction. Again a difficulty is encountered when we examine another of our author's fundamental principles, the inheritance of acquired characteristics, because the *assertion* of this principle is made and yet no demonstration of its truth is offered—it is at best a bold hypothesis.

Another peculiarity of the author's position is his serious misapprehension of Darwin's theory, which he mistakes repeatedly. He rejects Darwinism because it does not explain the origin of variations. Darwin, of course, did not attempt to more than suggest certain explanations, and his theory of natural selection does not depend on the origin of variations, but on the demonstrated fact that innumerable variations do occur and numerous variations have been transmitted. Prof. Eimer claims that his book should be 'read *and studied*,' in return we claim that before he again writes against Darwin, he should thoroughly master Darwin's chief work, the '*Variation of Animals and Plants*.' Until he has done that his attacks must remain unheeded, for they are only against a straw substitute for Darwinism.

Professor Eimer's book is a valuable contribution to descriptive entomology, and sets before entomologists a high standard of description and illustration of species. It is also an unsuccessful attempt to substitute for Darwinism a new theory of evolution, based wholly upon hypothetical assumptions, for no one of which is substantial proof offered, and so far from agreeing to the author's claim that his theory is a series of facts, we must, on the contrary, say that it is a collection of arbitrary assertions. He condemns Weismann very emphatically for speculating, and yet shows himself, perhaps, the more speculative of the two.

C. S. Minot.

The Structure and Life of Birds. By F. W. Headley, M. A., F. Z. S. London, Macmillan & Co. 1895. 8vo. Pp. xx. 412. 78 illustrations. $2.00.

This book "attempts to give good evidence of the development of birds from reptilian ancestors, to show that modifications in their anatomy have accompanied their advance to a more vigorous life, and, after explaining, as far as possible their physiology, to make clear the main principles of their noble accomplishment, flight, the visible proof and expression of their high vitality. After this it deals, principally, with the subjects of color and song, instinct and reason, migration and the principles of classification, and, lastly, gives some hints as to the best methods of studying birds."

Mr. Headley's aim is confessedly an ambitious one, and since he has shot so well he must not take it amiss if he is told that his pen has not carried quite true throughout its entire flight. It is difficult to compress so many subjects as are contained in the 'Structure and Life of Birds' into the compass of four hundred pages, and we can not expect to have every point touched on fully and clearly explained. Still, making due allowance for this and for the popular audience to which the book is largely addressed, there is a certain amount of looseness, or inexactness, of statement that might have been avoided. For example, uncinate processes are not 'common to all birds,' since they are absent in the Screamers, a fact which might have been explained in half a dozen words. Neither is the supplementary toe of the Dorking Fowl a dermal bone, but a case of duplication of a digit, the perpetuation by careful breeding of an abnormality now and then seen among animals, even in man. This looseness of diction is well shown by the constant reference to bones filled with marrow as *solid* bones; and the statement that the coracoid and clavicles are firmly fixed to the breast bone, when this is rarely the case; and those birds in which the clavicle is most securely fastened to the sternum are by no means among our best birds of flight. The statement that all the bones of the Swallow are filled with marrow is a little indefinite, and if intended as generalization, misleading, since the humerus may be pneumatic, even among Swallows.

However, pneumaticity is a very inconstant character and is not even of generic value. The connection between the reduced phalanges of the Swift and its alleged inability to rise from the ground is not clear to the average mind, and it is rather startling to be told that the Rook may be told from the Crow by the absence of feathers on the beak.

It would also have been well to have avoided positive statements concerning facts or theories still in debate, especially such an one as that the skull is no doubt partially made up of vertebræ, or that the pisiform is an ossified tendon. Neither do we *know* that an insect gets a mosaic picture of an object, while, had Mr. Headley heard the question of the sense of smell in *Cathartes* discussed, he might not be so certain that vultures do not scent carrion from afar, although neither that nor the contrary is yet proven. In discussing flight too much stress is laid on the importance of the clavicle. As the author states, the bone is rudimentary in parrots which fly exceedingly well, while any one who has dissected humming-birds will be morally sure, from its shape and insignificant proportions, that these birds could dispense with the bone. We are told that the wing serves as a parachute to sustain the bird between the strokes of the wing and, but for this, the drop would be greater than it is. A more obvious explanation would seem that there is not sufficient time for gravity to overcome the inertia of onward movement, for it is very evident that unless a bird is falling more rapidly than the wing is being raised, the wing can afford no support. Many other things might be said—did space allow—concerning the chapter on flight, but it will suffice to remark that there is as yet no proof that the muscles of birds exert any unusual power; on the contrary, birds which like the larger petrels have mastered the problem of sailing flight, not only have small wing muscles, but have very little strength in them, and it was pleasing to obtain from Prof. Moseley's notes corroborative evidence of the inability of the Cape Pigeon (*Daption*) to rise from the water after a hearty meal.

A word or two on another point. Why does Mr. Headley confuse the reader by calling both the leg of a man and the wing of a bird the homologue of the arm, when a better and clearer expression would be that the fore limb is the homotype of the hind?

But in spite of blemishes, some of which have been cited to warn the reader to be on his guard, and to use a pinch of salt now and then, the 'Structure and Life of Birds' is a most interesting book and a welcome addition to ornithological literature. Many of the errors may be ascribed to the fact that the author is so brimful of his subject that, writing as he does *calamo currente*, his ideas outstrip his pen and are incorrectly recorded. The style is bright, clear and readable, the illustrations illustrate and are not thrown in, while the numerous bibliographical references are not only a boon to the reader who would like to know how he may best extend his knowledge, but to him who would like to know on whose authority some of the statements are made. The book is evidently based on much observation and experiment, supplemented by a vast amount of reading, and it will give the general reader, and many a one who considers himself an ornithologist, a good idea of many of the facts and problems concerning birds. The reader will learn why the perching bird does not fall from the bough, even when asleep, will find full details of the wonderful air sacs with which the body is permeated, and much information as to how a bird breathes and how his blood circulates. He will gather that the colors of feathers are due to a variety of causes, and learn that they correspond to the scales of snakes as well as much of their growth and mode of shedding and renewal.

The chapter on flight is particularly full and interesting and this difficult matter is well treated, and it is to be hoped that the concluding chapter may stimulate some, at least, of its readers to address themselves to some of the many branches of ornithology which lie ready to their hand. Lastly, but by no means least, the book is well indexed.

F. A. LUCAS.

The Beginnings of Writing. By WALTER JAMES HOFFMAN, M. D. With an introduction by PROF. FREDERICK STARR. New York, D. Appleton & Co. 1895. Pp. xiv+209.

In this latest volume of the 'Anthropological Series' Dr. Hoffman has attempted to present in brief and popular form the results up to date of the researches into the origin of the art of writing.

The development of the use of conventional signs is traced from pictographs through symbols, mnemonic signs, etc., to alphabets, and the result is a work not only of interest to the lay reader, but of considerable scientific merit and usefulness. The difficulty of selection from the mass of material, much of it of doubtful interpretation, to say the least, which the author had at his disposal must not be underestimated and to say, as we may, that he has accomplished his task with judgment is no mean praise.

The first four chapters of the book are taken up with a discussion of pictography, both descriptive and interpretative, and here, as was to be expected from the previous work of the author in the picture-writing of the North American Indians, he shows himself thoroughly at home. One of the main faults of the book may be mentioned here, and that is the almost overwhelming prominence given to American remains and records in nearly every question under discussion, a fault easy to understand when the volume of research and even relative importance of the pictographic remains of the aborigines of this and other countries is considered, and yet the idea of proportion which the general reader would obtain from the book must inevitably be a wrong one.

Of pictographs on stone those of the 'Algonkian type' are the most numerous and widely distributed, corresponding to the great area occupied by tribes of the linguistic family of that name. They appear to be mainly representations of animals or concrete objects and probably served as hunting or other records. The author points out that in nearly every instance these Algonkian petroglyphs have been placed upon rocks low down along the shore of water courses, whereas many of the pictographs of other types are placed upon high and conspicuous cliffs, in which case the drawings are apt to be colored.

In Mexico and Central America, petroglyphs are comparatively rare, while in South America investigation is at present not far enough advanced to present examples of much importance.

In the chapter on pictographs on materials other than stone, the art is traced through carvings and drawings on ivory, bone and shell, in which the Alaska Innuits especially excel, through birch bark records to the use of maguey paper by the Mexicans and papyrus by the Egyptians. The Mexican pictographs show a very high degree of development in which the artists had passed the stage of mere concrete object drawing, and show signs of a beginning system midway between the pictographic and the phonetic. This system which has been called the 'ikonomatic' is one in which "the object employed to represent a complex word or character, each furnishes its first syllable, or more, to suggest the sound required for the complex character and may have no other relation to the general result." Colors were largely used and may have had a phonetic value, though often were nothing more than the natural color of the object depicted.

Dr. Hoffman denies that any evident parallel exists between the pictographs of the Western hemisphere and those of the East. The Egyptian had become entirely phonetic and partly alphabetic, while the Chinese and other systems were of a well developed syllabic order; the American aborigines, on the other hand, had not yet risen above the stage when a study of the origin of their pictographs is possible, and therein lie their peculiar interest and value.

The chapters on symbolic signs and gesture signs and attitudes are especially good and well arranged, while those on the growth of conventional signs and comparisons give interesting examples of primitive designations from which space prevents our quoting.

The book closes with a discussion of the growth of the alphabet through the various stages of graphic development; the transition stages where the alphabetic character has served as a pictorial representation of an object and as a syllable being proved, as indicated above, by reference to the systems in use among the early Mexicans and the Mayas of Yucatan.

Ikonomatic or rebus writing was extensively used by the Mexicans, while the Mayas went a step further and employed purely phonetic signs as well as ideographic characters.

In conclusion it may be said that Dr. Hoffman has raised very markedly the standard of the hitherto somewhat disappointing series in which his book appears, a standard which it is to be hoped the succeeding issues will sustain.

LIVINGSTON FARRAND.

COLUMBIA COLLEGE.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, NOVEMBER–DECEMBER.

The Greenland Expedition of 1895: By R. D. SALISBURY. This is not an itinerary of the expedition, but a discussion of the geologic and geographic problems suggested in the course of it. The following are considered: coastal topography and its interpretation, evidence concerning past glaciation from nature of rock surfaces, general distribution of snow and ice, icebergs and evidences concerning recent changes of level. The time allowed was not sufficient for detailed observation on any of these lines, but the facts gathered are of especial significance as supplementing and checking as well the work of last summer in this little known field. The author finds strong evidence that the Pleistocene ice sheet of America did not come from Greenland, and that the conditions for glaciation on the coast of Greenland to-day are better in latitude 74°–76° than in 76°–79°. Another interesting conclusion is that the ice cap of Greenland did not reach its greatest extension at all points at the same time. The observations on icebergs are quite full and show clearly either that there was little debris in the parent glaciers, or that it was quickly lost by the bergs.

A Circum-Insular Paleozoic Fauna: By S. WELLER. So long as paleontology made the identification of species an end in itself and assumed that forms found widely separated in space must belong to different species, even though they seemed to be identical, it was necessary doubtless, but it was not interesting to the philosophic geologist, because it seemed to him to ignore more than it considered. In later years there has been a decided broadening in the view of paleontologists. Under the lead of Williams, Walcott and Smith in this country there has been an attempt to solve the same kind of problems for ancient faunas and floras which Wallace, Darwin, Gray and others have solved for modern ones. In this paper the author applies the method in determining the origin of the Chouteau fauna of the Ozark area in southeastern Missouri. He finds evidence of a land barrier extending from 'Isle Wisconsin' southwest through this area in early Devonian time which separated two rather distinct faunas. In the latter part of the Devonian this land barrier became sea bottom, and the two faunas mingled freely in the Ozark area. The result was a new fauna decidedly Carboniferous in its affinities, though Devonian in time. The most hardy elements of the two competing faunas survived, and this new vigorous stock gave character to succeeding faunas for a long period. Some pregnant suggestions are made regarding correlation of formations.

Experiments in Ice Motion: By E. C. CASE. The mechanics of glacier motion involve questions often asked but not easy to answer. The experiments of the author were designed to throw light on the existence and nature of differential movement in the basal portions of glaciers. Paraffine with a quantity of refined petroleum to lower the melting point was the material used. It was placed in a box with various obstructions in the bottom and by means of a close fitting plunger was forced toward the middle of the box over the obstructions. In order to trace the currents, thin lines of powdered coal or Galena, and layers of dark wax, were used. The results, as shown by the photographs, tally well with Prof. Chamberlin's descriptions of some Greenland glaciers. The author finds proof of both vertical and horizontal differential movements in the basal portion of the wax. Similar currents in glaciers he thinks may be the cause of certain features of subglacial topography. For example, he finds that drumlin areas lie in the lee of escarpments or other irregularities of hard rock over which the ice has just passed.

Absarokite-Shoshonite-Banakite Series: By J. P. IDDINGS. This is a study of a peculiar series of igneous rocks associated with the normal andesites and basalts of the Yellowstone National Park, but differing from them mineralogically and chemically. These rocks are arranged under the three groups named in the title, of which the first contains the least SiO_2 and the third the greatest amount. The author concludes that this is a series variable in two principal directions chemically: in the ratio of alkalies to silica, and also in the silica percentages. The variations of other chemical constituents are to some extent functions of these variables.

Distribution of Gold Deposits in Alaska: By

GEO. F. BECKER. During the past summer the author was sent by the U. S. Geological Survey to investigate the gold resources of Alaska. This paper is a very brief resumé of the results. He finds nothing phenomenally rich, but that there are paying quantities of gold in several localities seems clear from his account.

In this number there is a new department, viz: Authors' Abstracts. Under this will be found abstracts of a variety of geological publications, including some of the new U. S. Geological Atlases.

AMERICAN JOURNAL OF SCIENCE.

THE January number opens Volume I. of the Fourth Series, or Volume CLI. since the establishment of the Journal in 1818. The leading article is by W. M. Davis upon the quarries in the Lava Beds of Meriden, Conn. This locality exhibits with great distinctness at the present time the two lava beds composing the ridge at that point, and the fractures by which the beds are faulted. These igneous outflows in common with most of the others which characterize the Triassic of Connecticut are viewed as extrusive lava beds, once horizontal and continuous, but now tilted, dislocated and denuded. The present paper discusses in detail the present relations of the outflows, with a number of idealized illustrations showing their position with reference to the accompanying sandstone and shales. It is urged that the former may be used as well as the latter in the study of the stratigraphy. A second geological paper is by Stanton and Vaughan, and describes minutely, with a diagram, the Cretaceous section exposed in Mexico and New Mexico, near the Initial Monument of the Mexican boundary survey, three miles west of El Paso. G. W. Littlehales discusses, from a mathematical standpoint, the form of isolated submarine peaks with reference to their relation to the intervals at which deep-sea soundings should be taken in searching for probable shoals in the open ocean. E. H. Forbes gives an analysis of the epidote from Huntington, Mass., with a discussion of its optical properties and, further, their relation in general to the composition of the species. H. L. Wells and H. W. Foote describe a series of double fluorides of Cæsium and Zirconium; analyses of the salts $2\,Cs.ZrF_4$, also $CsF.ZrF_4.H_2O$ and $2\,CsF.3ZrF_4$. $2H_2O$ are given. Other chemical articles are by F. A. Gooch and A. W. Peirce on the iodometric determination of selenious and selenic acids, and by P. E. Browning on the interaction of chromic and arsenious acids. A. M. Mayer gives a note on the Analysis of Contrast-Colors by viewing, through a reflecting tube, a graded series of gray discs, or rings, on colored surfaces. This is based upon the fact, noted by Rood, that the mixing of black with certain colors simply darkens them, while with other colors the effect is to change the hues. A new form of cathetometer of simple construction is described by F. L. O. Wadsworth, with a series of figures and a half-tone plate showing the instrument in use. The novel feature is the employment of a light silvered mirror mounted on a vertical axis just in front of the objective. By means of this the comparison of the object to be measured with standard scale is readily made. It is shown that highly accurate results may be obtained with this instrument, while the cost is relatively very small. O. C. Marsh details some observations made of globular lightning from notes taken at the time of its occurrence at Southampton in July, 1878. The circumstances were such that this rare phenomenon could be more minutely and accurately observed than is often possible.

The concluding thirty pages of the number are devoted to abstracts of scientific papers, notices of books, etc., on a wide range of subjects.

SCHOOL OF MINES QUARTERLY, NOVEMBER.

THE November number of the School of Mines Quarterly has recently appeared, J. F. Kemp taking the place of A. J. Moses as managing editor, as Dr. Moses is in Europe on a year's leave of absence. The table of contents contains the following: 'The Missouri River,' by George R. Morison; 'Temperature of Gases from Lead Furnaces' and 'Temperature of Lead Slags,' both by Malvern W. Iles; 'The Assay of Platinum,' by E. H. Miller; 'Lecture Notes on Rocks,' by J. F. Kemp; 'The Study of Architectural History at Columbia College,' by Wm. R. Ware. The first paper describes the peculiar features of the Missouri River and the difficulties met and surmounted in constructing and maintaining bridges across it. The author is reputed to have built more bridges than any other living engineer, and presents an interesting account of his experiences. The next two give the results of a series of experimental determinations of the temperatures mentioned in the title. In the fourth paper the results are detailed of an extended series of experiments on a difficult subject and the final attainment of a feasible and a not too long method. The fifth paper, which will be a serial, contains the opening chapters of a manual on rocks for use without the microscope. The last paper emphasizes the importance of teaching architecture as an art, comparable with artists' as distinguished from engineers' or artisans' work. As outlining a future policy for our schools of architecture it has important bearings.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, SECTION OF BIOLOGY.

THE following papers were presented on December 9th:

Prof. C. L. Bristol: 'The Classification of Nephelis in the United States.' The study of abundant material, collected from Maine to South Dakota, has shown that the color characters cannot be depended upon for specific determination. An examination of the metameral relations of this leech indicates that no more than a single species occurs in this country.

Prof. H. F. Osborn: 'Titanotheres of the American Museum of Natural History.' The complete skeleton of Titanotherium robustum is remarkable in possessing but twenty dorsolumbar vertebræ, a number identical with that typical of the Artiodactyla, but entirely unique among Perissodactyla. It now appears probable that the development of horns in the Titanotheres became a purely sexual character, and that the genera Titanops, Marsh, and Brontops, Marsh, are founded respectively upon male and female individuals of Titanotherium robustum.

Dr. J. L. Wortman: 'The Expedition of 1895 of the American Museum of Natural History.' The expedition passed into the Unita beds of northeastern Utah, then between the eastern escarpment of the Unita range and the Green River into the Washakie Beds of southwestern Wyoming, the most important result geologically being that the Brown Park deposit is found to be of much later age than the Unita.

BASHFORD DEAN,
Rec. Sec'y, Biological Section.

SECTION OF GEOLOGY AND MINERALOGY.

THE Section of Geology and Mineralogy of the New York Academy of Sciences assembled for its regular monthly meeting Monday, December 16, 1895, Prof. J. J. Stevenson presiding.

The first paper was by Prof. H. P. Cushing, 'Notes on the Areal Geology of Glacier Bay, Alaska.' The paper will appear in full and with a geological map in Vol. 15 of the Transactions of the Academy, but the following is an abstract:

After an introduction which outlined the previous work in the region by Dr. H. F. Reid and the writer and the petrographical determination of the rocks that had been collected by them, and that had been studied by the late Dr. George H. Williams and the writer, a description of the general geology was given, based upon a geological map.

Mr. Cushing shows that the rocks present are argillites, limestone, quartz-diorite, diorite, crystalline schists and dikes of diabase. The argillites have a wide distribution around the eastern side of the Muir glacier basin, and also form the mountains adjacent to Muir Inlet. They present three main phases: First, very hard, fine grained argillo-siliceous beds, gray to brown in color, occasionally approaching quartzite in character. Second, blue and black, somewhat slaty rocks, nearly as hard as the first, and equally fine grained, but less siliceous, although containing only a slight amount of calcareous manner. Third, thin bands of black graphitic slates, with good slaty cleavage, and interstratified with the other two varieties. No fossils were found, although careful search was made.

The limestone is called the 'Glacier Bay Limestone.' It is dolomitic, and for the most part extremely pure, containing only a trace of insoluble matter. Fossils were rare and so damaged by metamorphism as to be unrecognizable. But in 1893 a fossil coral was brought from the region by Prof. Stevenson, which had certainly been derived from this limestone. It was identified by Prof. H. S. Williams as a species of *Lonsdaleia*, and was regarded as demonstrative of the carboniferous age of the beds.

The quartz-diorite is a homogeneous rock, consisting of white plagioclase, with frequent thin prisms of hornblende, and occasional biotites and some quartz. A contact was found between it and the argillites which seemed clearly an irruptive one. Other contacts observed by Dr. Reid with the limestone also indicated contact metamorphism.

The diorite is a more basic rock than the quartz-diorite, and is found in the moraines. It has probably come from the mountains, which have yet proved inaccessible.

The crystalline schists embrace mica schists and actinolite schists and were obtained from erratic blocks.

The diabase dikes have all been intruded since the metamorphism of their wall rocks and are the latest rocks in the region. Mr. Cushing gives a detailed comparison of these rocks with other Alaskan sections, noting many parallel features and some contrasts. The paper concludes with a detailed petrographical description of the crystalline rocks.

The second paper of the evening was by Heinrich Ries, on 'The Geology of Orange County, New York.' Mr. Ries gave a resumé of the results obtained by him while in the field the past summer under Prof. James Hall, State Geologist, to whom the report will be made. The paper was extemporaneous and was not intended for publication. It was illustrated by numerous lantern views and geological sections.

The third paper was by Theodore G. White, on 'The Faunas of the Upper Ordovician Strata at Trenton Falls, New York.' Mr. White described the results of a visit to this, the typical locality of the Trenton formation, and of a detailed study of the faunas of each stratum of the limestones at Trenton Falls, and Poland, Oneida County, New York. The work was undertaken in connection with a doctorate thesis on the Trenton Faunas of the Lake Champlain Valley, which will be submitted in the spring to the Faculty of Columbia College. The faunal lists at Trenton Falls will be published in full in the Transactions of the Academy of current date.

By making use of conspicuous and constant layers as datum planes, the thickness of the beds in the Trenton Falls gorge was found to be 331 feet. On the same creek, three miles below Poland, underlying strata were found as follows:

Black River limestone, 11 feet 9 inches.

'Dove' limestone, 5 feet 1 inch.

Calciferous strata, 8 feet.

Various peculiar distortions of the beds in the Trenton Falls gorge was also shown and discussed.

The paper was illustrated by numerous lantern views from photographs.

The fourth paper of the evening by J. F. Kemp and T. G. White, 'Additional Notes on the Distribution and Petrography of the Trap Dikes in the Lake Champlain Region,' was postponed until the next meeting, on account of the lateness of the hour.

J. F. KEMP,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 250TH MEETING, NOVEMBER 30.

THE first paper, *Some Fundamentals of Nomenclature*, by Dr. Edward L. Green, is printed in abstract in this journal.

Mr. Theo. Holm made some *Contributions to the Flora of the District of Columbia*, illustrating the same by specimens. Since the publication of the third list of additions to the flora many rare plants have been reported, some of which are new to the District. It was shown that the genus Panicum is exceedingly well represented in the local flora, and seven species were enumerated as not having been before reported. *Sporobolus vaginæflorus*, which was formerly known only from one locality, has now spread to several distant places and may be considered as rather common. Several rare Cyperaceæ were reported, among which *Kyllinga pumila* and *Cyperus aristatus* were new to the flora. The genus Polygala appears, like Panicum, to be widely distributed in the District, and *P. ambigua*, *P. incarnata* and *P. verticillata* were reported from several places. *Plantago Patagonica*, var. *aristata*, had commenced to spread so as to become a weed in the eastern part of the District. After enumerating a number of similar plants rare in the District, the speaker made some brief remarks upon the morphology of some of these, *e. g.*, *Pogonia ophioglossoides*, *Orchis spectabilis*, *Smilax herbacea*, etc.

The evening was devoted to an address by by the President, Surgeon General George M. Sternberg, U. S. A., on the Practical Results of Bacteriological Researches.

F. A. LUCAS,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

AT the 241st meeting of the Society held December 17th, a paper on 'The Animistic Vampire in New England' was read by George R. Stetson. This superstition of ancient Babylonia, Chaldea and the far East by some mysterious survival, occult transmission or remarkable atavism, is prevalent in the scattered hamlets and more pretentious Villages of central Rhode Island. It is an extraordinary instance of a barbaric superstition out cropping in, and coexisting with a high general culture, and which is not so uncommon, if rarely so extremely aggravated, crude and painful.

The superstition is there unknown by its proper name. The local belief, however, precisely corresponds to the statement of the vampire superstition contained in Calmet's 'Traité sur les apparitions des esprits et sur les vampires ou les revenans de Hongrie, de Moravie, etc,' Paris, 1751, and as it now survives in eastern and western Europe.

It is, that a wasting disease is not a physical, but a spiritual ailment, obsession or visitation; that as long as the body of a dead relative of the person attacked has blood in its heart it is proof that an occult influence steals from it for death, and is at work draining the blood of the living into the heart of the dead and causing his rapid decline and death.

As in the middle age, the Rhode Island vampire is located, if, on opening the grave, the body is found to be of a rose color, the beard, hair or nails renewed and the veins and heart filled with blood.

The means taken for relief are also precisely those followed in parts of the Levant and elsewhere, viz: exhumation of the body and burning the heart and scattering its ashes to the winds. The persons indulging in this superstition in Rhode Island are not foreigners, but native born New Englanders. It is declared upon excellent authority to be prevalent in all the isolated districts of the southern parts of the State and that many instances of it can be found in the large centers of population.

As to its origin in Rhode Island there is no record; it is in all probability an exotic like ourselves, originating in the mythographic period of the Aryan and Semitic peoples.

No known precise parallel in the western Indian mythology has come to our knowledge. The Ojibwas and Cherokees have, however, something analagous.

Abundant evidence is at hand that the animistic vampire superstition still retains its hold in its original habitat; an illustration of the remarkable tenacity and continuity of a superstition through centuries of intellectual progress from a lower to a higher culture, and of the impotency of the latter to entirely eradicate from itself the traditional beliefs, customs, habits, observances and impressions of the former.

Mr. William Eleroy Curtis read a paper on the Regulation of the Social Evil in Japan, reviewing the legislation and imperial edicts that have appeared on that subject and describing the present method of confining prostitution to certain quarters of the cities and towns and making those who practice that profession practically prisoners under the constant surveillance of the police. The government of Japan prohibits any woman from following the business of a courtesan without the written consent of her parents, or her guardian, if she be an orphan, and requires her to make a contract for a term of years with the keeper of some hashi-zashiki, as the houses of prostitution are called. During this period she is not permitted to leave the limit of the Yoshiwara, as the quarter is designated, except on certain occasions which are enumerated in the law, or upon the expression of a desire to reform. When her contract is cancelled her license is surrendered, and she becomes a ticket-of-leave woman, subject to police surveillance until she has demonstrated the sincerity of her intention to lead a different life. The patrons of the Yoshiwara are required to register their names, residences and occupations in books that are always accessible to the public and the police, and an account of their expenditures is accurately kept.

Mr. Curtis asserts that this system has been remarkably successful both from a sanitary and a moral point of view.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 112th regular meeting was held December 5, 1895. Mr. Hubbard read a paper on 'Distribution of Certain Species of Mytilaspis.' He spoke of the unreliability of tradition and early records as a source of exact knowledge concerning the introduction and spread from one country to another of scale insects which are so easily transported and difficult of specific identification. He refered particularly to the published accounts of the introduction into Florida of *Mytilaspis gloveri* and *M. citricola.* The former is supposed to have been brought to Mandarin in 1838 by Mr. Robinson, on two trees obtained in New York from a ship which came from China, and the latter was said to have been brought to Florida some years later upon lemons from Bermuda. According to the speaker, both of these positive statements, hitherto unchallenged, are probably erroneous. The insect mentioned by Glover as having been brought from Bermuda is not a Mytilaspis, and *M. citricola* at that time had not yet reached Europe from the East. It certainly did not reach Florida much before 1880. *M. gloveri* is to-day the principal pest of the orange in the interior of Mexico, and it is probable that it was introduced with the orange into Florida and Mexico by the Spaniards at the end of the 16th or beginniug of the 17th century. Its appearance in 1838 was only the continuation of an epidemic of Coccid pests of the orange which is known to have overwhelmed the citrus plantations of Europe in the early part of the century, and to have spread westward sometime later to the Azores, Canaries, and finally to Bermuda. The speaker suggested that the obvious tendency to variation in form and thickness among the scales of Mytilaspis had produced in North America from an original tropical species *M. pomorum*, *M. citricola* and *M. gloveri.*

Dr. Stiles exhibited a Dermestes larva taken from a corpse 3 to 6 months after death. He referred to the statement by Mégnin in his 'La Faune des Cadavres,' that the period from burial of a corpse to its final dissolution may be divided into eight portions, each of these portions being characterized by the presence of a different series of insects. In regard to the manner in which insects gain access to a corpse, Mr. Hubbard said that with the Diptera the egg must be deposited on the outside of the coffin before burial, since he does not believe it possible for the young larva to make its way through the soil after burial. Dr. Stiles said that he did not agree with Mégnin in many of his conclusions, but considered the field a very interesting one for investigation by entomologists.

L. O. HOWARD,
Secretary.

[Abstract of report by D. W. Coquillett, Acting Secretary.]

ACADEMY OF SCIENCE, ST. LOUIS, DECEMBER 16, 1895.

THE Academy held its regular meeting at the Academy rooms with President Green in the chair and twenty-eight members and visitors present.

The committee to nominate officers for the ensuing year made report of following nominations :

President, Melvin L. Gray.
1st Vice-President, Edmund A. Engler.
2d Vice-President, Robert Moore.
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Prof. J. H. Kinealy presented his new instrument for testing the purity of air in buildings and gave an explanation of the method employed.

A. W. DOUGLAS,
Recording Secretary.

SCIENCE

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SCIENCE

FRIDAY, JANUARY 10, 1896.

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ALASKA AS IT WAS AND IS, 1865–1895. *

IN 1864 the apparent hopelessness of the attempts to establish a workable trans-Atlantic telegraph cable led those interested in telegraphic communication with Europe to consider other means of attaining that end. It was thought that a short cable across Bering Strait might be made to work, and no doubt was entertained of the possibility of maintaining the enormously extended land lines which should connect the ends of this cable with the systems already in operation in Europe and the United States. A company was formed for this purpose, and an expedition to undertake the explorations necessary to determine the route was organized. The coöperation of the Russian and American governments was secured and the necessary funds subscribed. Searching for properly qualified explorers, the promoters of the enterprise consulted the Smithsonian Institution and were brought into communication with Robert Kennicott, of Chicago, a young and enthusiastic naturalist, who had already made some remarkable journeys in the Hudson Bay Territories in the interest of science. His explorations had taken him to the most remote of the Hudson Bay posts—Fort Yukon on the river of the same name—regardless of every kind of hardship,

* The annual presidential address, delivered before the Philosophical Society of Washington, December 6, 1895, by W. H. Dall.

privation and isolation. His ardor was so contagious that before returning to civilization he had communicated it to almost every one of the hard-headed fur traders in that remote and inhospitable region, and for years afterward bird skins, eggs, ethnological specimens, and collections in every branch of natural history, poured from the frozen north into the Smithsonian Museum by hundreds and thousands.

When Kennicott, after traveling for months on snow-shoes, sledges, or bateaux, stood at last on the steep bluff at Fort Yukon, he saw the yellow flood of the great river surging by the most remote outpost of civilization and disappearing to the westward in a vast and unknown region. An uninhabited gap of hundreds of miles lay between him and the nearest known native settlement to the west. Far in the north the midnight sun lighted up the snowy peaks of the Romanzoff mountains, whose further slope it was believed gave on the Polar sea. No one knew where the Yukon met the ocean. On most maps of that day a large river called the Colvile, found by Simpson on the Arctic coast as he journeyed toward Point Barrow, was indicated as the outlet of the Yukon watershed. South of the Romanzoff mountains for an unknown distance vast tundras, scantily wooded with larch and spruce, the breeding grounds of multitudes of water fowl, intersected by many streams, but level as a prairie, extended to the west.

The native population of this region, as far as known, had always been scanty, and an epidemic of scarlet fever, introduced some years before through contact with other tribes trading to the coast, had swept them absolutely out of existence. Not an individual was left, and the nomadic natives who reached Fort Yukon from the east and southeast hesitated to approach the hunting grounds, where the mysterious pestilence might linger still.

Obliged to terminate his explorations here, Kennicott returned, after months of weary travel, to the United States, but cherished the hope of some day penetrating the *terra incognita* on whose borders he had been obliged to pause and turn away. The dream of his life was thereafter the exploration of Russian America, the discovery of its fauna, and the determination of its relations to the fauna of Siberia and Japan. The group of young zoölogists which gathered about him at the Chicago Academy of Sciences, an institution of which Kennicott was practically the creator, was frequently roused to enthusiasm by impromptu lectures on the problems to be solved, the specimens to be collected, and the adventures to be anticipated in that virgin territory.

The need of the telegraph company for one familiar with life and conditions in the North brought him the long sought opportunity, and he undertook to lead the exploration, provided he was permitted to utilize it for science to the fullest extent commensurate with the attainment of the objects of the expedition. He stipulated that he should be permitted to select a party of six persons who should be qualified to make scientific observations and collections in the intervals of other work, but who should hold themselves ready to do any work required by the promoters of the enterprise, even to digging post-holes for the line if called upon.

His terms were accepted, and the scientific corps of the exposition organized and started for San Francisco. Here two of the members were detailed to join the party engaged in exploring the route through British Columbia; the others, of whom the speaker was one, accompanied Kennicott to the north.

In July, 1865, the exposition entered the bay of Sitka and our acquaintance with Russian America began.

Sitka was then a stockaded town of about 2,000 inhabitants, with a village of more than 1,500 Indians outside the walls. The settlement contained a Greek church, a Lutheran chapel, shipyards, warehouses, barracks, a clubhouse for the officers, a sawmill, a foundry where brass, copper and iron castings of moderate size were made, beside numerous dwellings. All the buildings were log structures, their outer walls washed with yellow ochre, the roofs chiefly of metal painted red. High above the rest, on an elevated rock, rose a large building, in which the governor of the Russian colonies had his residence. This, known to visitors as the 'castle,' was built of squared logs, with two stories and a cupola, and was defended by a battery. The warm colors of the buildings, above which rose the pale green spire and bulbous domes of the Greek church, seen against steep, snow-tipped mountains densely clothed with sombre forests of spruce, produced a picturesque effect unique among American settlements.

Outside the walls, along the beach, was a long row of large Indian houses, low and wide, without windows, built of immense planks painfully hewn out of single logs with stone adzes, whose marks could still be distinctly seen. They were entered by small, low doors, rounded above, so that he who came in must bend to an attitude ill suited to defense. The front of each house was painted with totemic emblems in red ochre. Their dimensions were sometimes as much as 40 by 60 feet, and the area within formed one large room, with the rafters visible overhead, the middle portion floored only with bare earth, on which the fire was built, the smoke escaping through a large square hole in the roof. On either side were raised platforms with small partitioned retreats like state rooms, each sheltering a single family. As many as one hundred people sometimes dwelt in one of these houses. The only ornaments were totemic carvings, generally against the wall opposite the entrance; overhead hung nets, lines and other personal property, drying in the smoke, along with strips of meat or fish and fir branches covered with the spawn of herring.

On the bank, which rose behind the houses, densly covered with herbage of a vivid green, were seen curious box-like tombs, often painted in gay colors or ornamented with totemic carvings or wooden effigies. These tombs sheltered the ashes of their cremated dead. On the beach in front of the houses lay numerous canoes whose graceful shape and admirable workmanship extorted praises from the earliest as well as the later explorers of the coast. When not in use these were always sheltered from the sun by branches of spruce and hemlock or tarpaulins of refuse skins. Among the canoes innumerable wolfish dogs snarled, fought, or played the scavenger.

The natives still retained to some extent their original style of dress, modified now and then by a Russian kerchief or a woolen shirt. As a rule they were barefooted, stolid, sturdy, uncompromising savages, who looked upon the white man with a defiance but slightly tempered with fear and a desire to trade. The mission church of that day was built into the stockade, with doors entering it both from the Indian and Russian town. When services were held, the outer door was opened, the town door closed and stoutly barred. Once these fierce clansmen had endeavored to rush into and take the settlement when the door leading inward had been left unfastened. From the time when the first white men to touch these shores, Chirikoff's boat's crew in 1741, were without provocation massacred, these natives had not failed to maintain their reputation for courage, greed, treachery and intelligence.

These conditions outside the settlement necessitated a military discipline within it.

Sentries regularly paced the walks by day and night, the sullen Indians were systematically watched, and the little batteries kept in readiness for use.

The needs of the business of the company made Sitka a lively manufacturing town, in spite of the multitudinous Russian holidays. Society there was like a bit of old Russia, with the manners, vices and sturdy qualities of sailor, peasant and courtier fully exemplified within its narrow limits. A fishery at Deep Lake, a few miles away, furnished fresh salmon in abundance, which was freely distributed to all comers, twice or thrice a week during the season. The company furnished each employee with certain stated rations of flour, sugar, tea, etc., at fixed prices; the harbor, within a few yards of the stockade, contained abundance of seafish, and the Indians' price for a deer, skinned and dressed, was a silver dollar or a glass of vodka. The primeval forest came close to the town; the demand for firewood and timber had made little impression upon it. White settlements in the Alexander archipelago were confined to a few small fortified trading posts. Fort Wrangell and Fort Tongass alone could be regarded as approximately permanent. The parties sent out to trade or hunt worked from a temporary camp or an armed vessel as a base, and, owing to the ill feeling which existed between the natives and Russians, smuggling and illicit trading were rife. Missionary effort did not exist outside of Sitka, and even there amounted to little more than the bribery of some greedy savage, to perform for a consideration some rites which he did not understand.

The law of Russia which prevented a permanent severance of a subject from his native soil (except for crime) operated to encourage temporary unions of the company's servants with native women. Marriages were not allowed between full-blooded Russians and natives, as, at the expiration of his term of service, the Russian must return to his own parish in Russia, and the native could not be carried away from the place of her nativity. After the transfer of Alaska to the United States many of these Russians elected to remain in the country and were married to the mothers of their children; but at the time of our first visit, the most surprising social fact to us was the perfect equality which appeared to subsist between these irregular partners and the married women who had come from Russia. So far as we could perceive, both classes behaved with equal propriety and were treated with equal respect by the community, and the only restriction which the authorities insisted upon was that no Russian should take to himself a partner who had not been duly baptized. The issue of these unions, being of Alaskan birth, were free to marry in the country, and with their descendants constituted the class to which the Russians gave the name of 'Creoles.' Some of them rose to eminence in the service, and one at least became governor of the colonies.

At the time of our visit the business of the colony was exclusively the development of the fur trade. Agriculture was confined to a trifling amount of gardening very imperfectly performed. The fisheries were utilized only to supply food for the people in the company's employ, or to insure subsistence for the natives whose time was devoted to hunting the sea otter or preparing skins for the authorities. The fur trade of southeastern Alaska was not very productive. The natives were disposed to trade with the Hudson Bay Company or illicit traders rather than with the Russians, partly because they obtained better prices for their skins and partly because the Russians refused to trade intoxicating liquors, while the outsiders were not troubled with any scruples in such matters. The furs were divided by the Russians into two classes—the precious furs, such as the fox, sea otter and sable, which were strictly reserved for the company, a certain proportion being imperial perquisites of the Russian court, and the cheaper sorts, which might be used by the company's employees for winter clothing, and were sold at a fixed price to them for this purpose. This included the muskrat, mink, Parry's marmot or ivrashka, the fur seal and some others. Dry skins of the fur seal were sold at the company's warehouse for 12½ cents apiece, the modern plucking and dyeing of the fur, invented by an American, Raymond, of Albany, not having reached a perfection sufficient to attract the fashionable world.

The European trading goods and supplies were mainly brought by ship from Hamburg, the same vessel taking the annual load of skins to China, where an exchange was made for tea and silk, which were carried back to Europe. Flour was imported latterly from California and some goods were brought from Aian and other ports on the Okhotsk sea in the earlier days of the business, but in 1865 this trade had come to a standstill or nearly so. In mineral resources almost nothing was done; a little coal was taken out at Cook's inlet for local uses, and the exportation of ice from Kadiak to California was carried on under a lease by an American company. The presence of gold, iron and graphite was known to the authorities, but prospecting was not encouraged, as it was supposed the development of mineral resources might react unfavorably on the fur trade.

The first codfisherman visited the Shumagin Islands in 1865. The whale fishery was wholly in the hands of Americans and other foreigners, uncontrolled by the Russians, and the timber was used only for local purposes.

The main business of the company was done at its continental trading posts in the northern part of the territory and in the Aleutian chain; its authority in the territory was as absolute as the presence of the uncivilized tribes would admit. Under the guns of the trading posts the company was master; out of their range every man was a law unto himself.

After transacting its business at Sitka, the expedition touched at the island of Unga to examine a coal mine, at Unalashka, the Pribiloff Islands, and at Saint Michael's, Norton Sound, where Kennicott and the explorers for the Yukon were landed. The speaker was put in charge of the scientific work of the expedition and remained with the fleet, visiting Bering Strait, where landing places for the cable were searched for; and Petropavlovsk, the capital of Kamchatka, where the Siberian parties were provided for; and then the vessels returned to San Francisco.

The following year, on returning to Saint Michael's, we were met by the news of Kennicott's death from heart disease, brought on by over-exertion and anxiety. The Yukon exploration was still incomplete, though information received made it certain that the Kwikhpak of the Russians and the Yukon and Pelly of the English were one and the same river. It remained to emphasize this information by a continuous exploration which should cover the unmapped portion of this mighty stream. The scientific work in zoölogy projected by Kennicott had been left by his premature death unrealized. The speaker determined to carry out these plans and was authorized to remain in the country for that purpose.

As soon as sufficient snow had fallen to render sledging practicable a portage from Norton sound to the Yukon river was traversed, a small boat transported on a sledge for use during the following summer, and the Yukon ascended on the ice to the trading post at Nulato, a distance of some three hundred miles. Here the party of five wintered and in March divided into two parts—one, under Frank Ketchum, taking sledges with the intention of traversing the unknown region on the ice and after reaching Fort Yukon to ascend further in canoes; the other to await the break-up of the ice in May and follow in the skin canoe, so as to rescue the first party should they have failed to carry out their plans. Both projects were successfully carried out and the two parties reunited at Fort Yukon on the 29th of June, 1867. They returned by the whole length of the river and reached Saint Michael's on the 25th of July. Here astonishing news awaited us: The Atlantic cable was a triumphant success, the United States were in negotiation for the purchase of Russian America, our costly enterprise was abandoned, and all hands were to take ship for California.

The collections and observations had been but half completed. The natural history of the Upper Yukon and the borders of Norton sound had been pretty well examined, but the vast delta of the Yukon, with its wonderful fauna of fishes and water birds, its almost unknown native tribes and geographic features, remained practically untouched. I immediately determined to remain and devote the following year to the unfinished work. An arrangement with the Russians was made and this plan carried out. In the autumn of 1868 I left Norton sound for California on a trading vessel and returned to civilization.

At the time our explorations of the Yukon began this immense region was occupied by two or three thousand Indians, many of whom had never seen a white man. The Russian establishments on the Yukon were only three in number, hundreds of miles apart, and chiefly manned by Creole servants of the company, not over a dozen at each post. An inefficient priest, with a few alleged converts, conducted as a mission of the Greek Church the only religious establishment in the whole Yukon valley. The industries of the region comprised trapping, hunting and fishing; the first for revenue, the others for subsistence. The means of navigation were birch-bark canoes and small skin-boats. Once a year the clumsy barkass of the Russians, loaded with tea, flour and trading goods, was laboriously forced upstream to the Nulato post, returning with a load of furs. The tribes of Eskimo extraction occupied the lower river banks from the sea to the Shageluk slough, above which they were replaced by Indians of the Tinneh stock. These were to be found in scattered villages at various points on the river or its tributaries, where the abundance of fish offered means of subsistence. The extreme limit of population was to be found at the junction with the Yukon of the large river Tananá, where the island of Nūklūkayét was recognized as neutral ground, where delegations from all the tribes met in the spring for their annual market of furs. Here our party had the interesting experience of meeting the delegation of Tananá Indians in full native costume of pointed shirts and trousers of dressed deer skin adorned with black and white beads, the nasal septum pierced to carry an ornament of dentalium shell, their long hair formed into a bundle of locks, stiff with tallow, wound with beads, dusted with powdered hematite and the chopped down of swans. The ranks of frail birch canoes were accurately aligned, and their paddles rose and fell with military precision. When they rounded the point of the island and approached the beach, where stood the first white men they had ever seen, they were met by a complimentary salvo from the guns of the Indians already on shore, and responded by wild yells and graceful waving of their paddles.

The waters of the Tananá had never known an explorer and its geography was wholly unknown. Never again will it be possible for an ethnologist to see upon the

Yukon such a body of absolutely primitive Indians untarnished by the least breath of civilization.

Above Nūklūkayet the Yukon enters a cañon, known as the Lower Ramparts, above which the depopulated area already alluded to extends to the site of Fort Yukon, near the British boundary on the Arctic circle.

The noble stream I have described extends, including windings, about 1,600 miles from Fort Yukon to the sea. The valley is sometimes wide and low, sometimes narrow, and contracted by low, wooded mountains. Everywhere until the delta is approached the banks are wooded. There are many tributaries, none of which were then explored, and on either side of the main artery the land stretched unexplored for hundreds of miles. Not another person speaking any European tongue, except the Russian, was resident in all this territory during the second year of my sojourn. Outside of the three trading posts, not a native had ever bought a pound of flour or an ounce of tea. The use of woolen clothing had hardly begun, and soap was a rare and costly luxury. I made the first candles ever molded on the Yukon, and but for the lack of hardwood ashes to furnish alkali would have tried my hand at soap. People lived on game and fish. The caribou was plentiful in the absence of rifles; the moose was not yet exterminated; the warm days of spring brought incalculable multitudes of ducks and geese, to say nothing of other water fowl; the Arctic rabbit and the ptarmigan were a constant resource, and the rivers and lakes in many places teemed with fish. Clothing was made of deerskin and sewed with sinew; the ornaments were fringes from the gray wolf or wolverine. Undergarments were occasionally made of cotton bought from the traders, but more usually from the skins of fawns. At one village during the season for taking them I saw 4,300 fawn skins hanging up to dry. Such reckless destruction has since borne its natural fruit. It was only at certain localities even then that deer were plentiful. The main staple of subsistence was fish. During the summer the river was studded with traps for salmon; in winter the traps were set in the ice, and under favorable conditions furnished a steady supply of white-fish, burbot, pike, grayling and the great red sucker. The salmon were cleaned, split into three parts connected at the tail, and dried in the open air by millions; they furnished food for man and dog, and when well cured were not unpalatable. Vegetable food was almost unknown, except in the form of berries. The green flower stalks of *Rumex* and *Archangelica* were occasionally eaten, and the dwellers by the sea sometimes gathered dulse, but for practical purposes the diet was meat and fish.

It was known that gold existed in the sands of the river, but the inexperienced fur traders looked for it in the bars of the main river and not in the side cañons of small streams, where it has since been found in such abundance. The real riches of the Yukon valley then lay in its furs. In a garret at Fort Yukon the post trader showed me with pardonable pride 300 silver fox skins of the first quality. Beautiful in themselves and for what they represented —gold, praises, and promotion in the service—one might almost forget that some of the company's servants at this post had not tasted bread or butter, sugar or tea for seven long years.

The region of the delta was, and is still, remarkable as being the breeding place of myriads of water fowl, some of which are peculiar to the Alaskan region. Nearly one hundred species gather there, and one of them comes all the way from North Australia, by the coasts of China and Japan, to lay its eggs and rear its young in the Yukon delta. It is also remarkable for the abundance of the great king salmon, sometimes reaching a weight of 130 pounds, a fish less plentiful further up and which does not ascend to the headwaters of the river.

All this immense Territory has since been penetrated by traders and prospectors. Stern-wheel steamers have defied the current, and ply regularly on the river during the season of open water. Mission schools are numerous and reindeer scarce. The fur trade wanes, while many thousands of dollars in gold dust have been laboriously extracted from the gravels. The natives buy tea and flour and dress in woolen clothing. With the miners whisky has reached the wilderness, and the sound of the American language is heard in the land. Tame reindeer have been imported from Siberia with a view to their domestication by the Eskimo of the Arctic coast, who are on the verge of starvation at frequent intervals, owing to the destruction of their food supply by the whalers and walrus hunters and the introduction of Winchester rifles for killing the wild deer. With the alternative of starvation as a stimulus, the chances of success ought to be good.

In carrying out the plans which Kennicott had meditated, but which death had stayed, I had succeeded in gathering rather abundant material for my friends, the ornithologists, botanists, ethnologists, and so on, but to do it I had to put aside the work in the department in which I personally was most interested. The shores of Norton sound and the tundra of the Yukon valley offered little in the way of mollusks or other invertebrates. The desire to extend our knowledge of the geographical distribution of the sea fauna led me to propose a further exploration of the coasts of the Territory, especially of the Aleutian chain, under the auspices of the United States Coast Survey. A geographical reconnaissance was undertaken and carried on during five years, investigating magnetism and hydrology, making charts, tidal observations, meteorological and hypsometric notes. In all this I was ably seconded by my companions, Mark W. Harrington and Marcus Baker, who need no introduction to this audience. At the same time, and without interfering with the regular work, the dredge was kept constantly busy, and on my return from field work the material for the studies I had so long looked forward to was actually gathered.

The region which includes the Aleutian chain and other islands west of Kadiak presents a striking contrast to the densely wooded mountains and shining glaciers of the Sitkan region to the east and the rolling tundra cut by myriad rivers in the North. Approached by sea, the Aleutian islands seem gloomy and inhospitable. Omnipresent fog wreaths hang about steep cliffs of dark volcanic rock. An angry surf vibrates to and fro amid outstanding pinnacles, where innumerable sea birds wheel and cry. The angular hills and long slopes of talus are not softened by any arborescent veil. The infrequent villages nestle behind sheltering bluffs, and are rarely visible from without the harbors. In winter all the heights are wrapped in snow, and storms of terrific violence drive commerce from the sea about them.

Once pass within the harbors during summer and the repellent features of the landscape seem to vanish. The mountain sides are clothed with soft yet vivid green and brilliant with many flowers. The perfume of the spring blossoms is often heavy on the air. The lowlands are shoulder high with herbage, and the total absence of trees gives to the landscape an individuality all its own. No more fascinating prospect do I know than a view of the harbor of Unalashka from a hilltop on a sunny day, with the curiously irregular, verdant islands set in a sea of celestial blue, the shorelines marked by creamy surf, the ravines by brooks and waterfalls, the occasional depressions by small lakes shining in the sun.

The sea abounds with fish; the offshore rocks are the resort of sea lions and formerly of sea otters; the streams afford the trout fisher abundant sport, and about their mouths the red salmon leap and play. In October the hillsides offer store of berries, and in all this land there is not a poisonous reptile or dangerous wild animal of any sort.

The inhabitants of these islands are an interesting and peculiar race. Their characteristics have been well described by Veniaminoff, who knew and loved them. By the testimony of their language, physique and culture they are shown to be a branch of the Eskimo stock, driven from the continent, as the shell heaps reveal, at a very ancient date and isolated since from contact with any other native race, specialized and developed by their peculiar environment to a remarkable degree. Conquered by the Russian hunters of the eighteenth century, practically enslaved for a century, their ancient religion frankly abandoned for the rites of the Greek Church, an apathetic reticence replaced the rollicking good nature characteristic of the Eskimo people. In 1865 they were supported by the company; the men shipped off in hunting parties in search of the sea otter were separated from their families sometimes for many months and rewarded according to their success; but, while the company provided food for all who needed it, the time of the Aleut was not his own. I have already mentioned that the fur seal at that time had very little commercial value. The fishery on the Pribiloff Islands was conducted by Aleuts under supervision, and the skins were mostly shipped to China or Europe. It has been noted as surprising that the value of the fur-seal fishery is so little referred to in the arguments urging the acquisition of the Territory in 1867. This was not an oversight; the seal fisheries at that time were not especially lucrative, and the millions which the industry has since produced could not have been predicted in 1867.

(*To be continued.*)

*A SIMPLEX SPECTROSCOPE.**

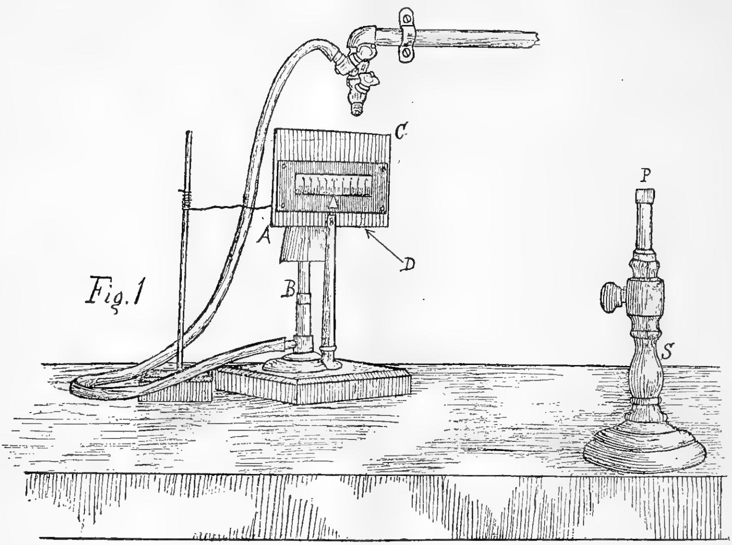
FOR the purpose of explaining the construction and operation of the spectroscope to beginners, the simplest form was desired and after various modifications of the usual form had been constructed, the following arrangement was devised and has proved eminently satisfactory, No lenses are required and only a small prism of fair quality.

The apparatus is shown in perspective in Fig. 1†. P is the small prism, about 1.5 cm. on a side and 60° refracting angle. B is an ordinary Bunsen burner with chimney. AC is a metal screen, supported upon a stand, and having a rectangular opening in its center covered by a scale in millimeters upon translucent paper or celluloid, covered upon the back with mica to protect it from the burner. Under the center of the scale is a triangular opening about 8 mm. high and 5 mm. wide at its base. The plan of the location of the parts is shown in Fig 2. The scale AC is about 50 cm. from the prism.

The operation of the spectroscope is as follows: The light from the burner B, passing through the opening D, falls upon the prism P and is refracted into the eye placed somewhere at E, and the light appears to come from a direction similar to D′ E. The scale is illuminated with a strong sodium light, obtained either by placing a 'sodium chimney' on the burner B, or by putting a sodium bead in the top of the flame. The scale being seen only by sodium light appears clear and distinct in

* Unpublished paper by Holbrook Cushman; edited by W. Hallock. See SCIENCE, December 6, 1895, p. 757.

† See SCIENCE, December 6, 1895, note on p. 761.



some position as at A′ C′. If, for example, strontium is introduced into the flame the observer will see a red triangle appear under the scale A′ C′ at some such place as D″, Figs. 2 and 3. If thallium is used a green triangle will appear as at D‴. In other words one can read the positions of the points of the colored triangles at the bottom of the scale, just as the positions of the colored lines are read on the scale in an ordinary spectroscope. A little practice and care will enable one to read the positions of the triangles to 0.1 mm, and thus to obtain about as good results as with the customary more elaborate and more expensive form. This little piece of apparatus has proved a great help in making the principles of the spectroscope thoroughly clear to students doing laboratory work. Of course it is desirable to have a black screen to prevent light from entering the eye from the direction of A′ C′. In fact it is very convenient to blacken the wall for a considerable space behind this apparatus.

Columbia College, December 10, 1895.

THE GEOLOGICAL SOCIETY OF AMERICA.

The Geological Society of America held its eighth annual meeting in the main building of the University of Pennsylvania, at Philadelphia, December 26, 27 and 28. The first session of the Council took place at the Hotel Lafayette at eleven o'clock on the 26th. The ballot for officers was canvassed with the following result:

President, Joseph Le Conte, Berkeley, Cal.; First Vice-President, Charles H. Hitchcock, Hanover, N. H.; Second Vice-President, Edward Orton, Columbus, O.; Secretary, H. L. Fairchild, Rochester, N. Y.; Treasurer, I. C. White, Morgantown, W. Va.; Editor, J. Stanley-Brown, Wash-

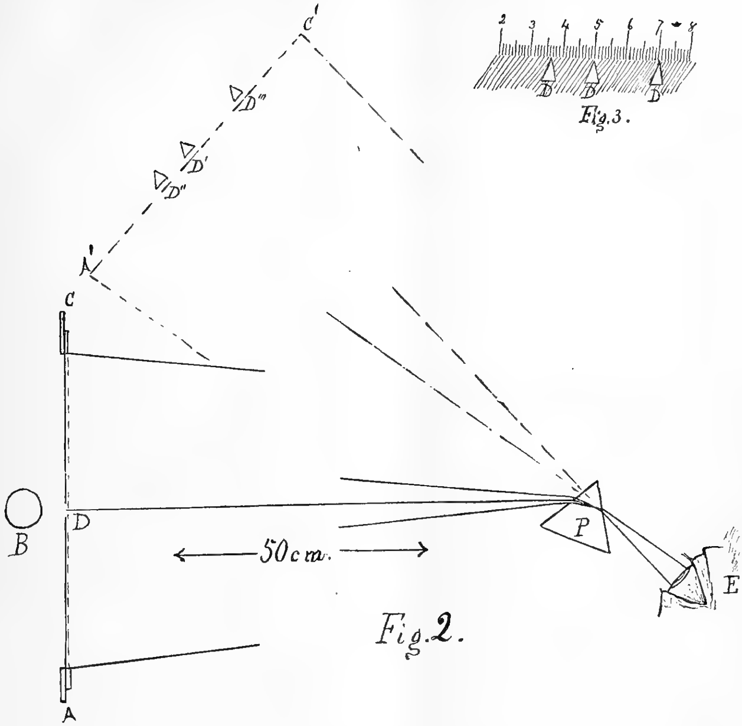


Fig. 2.

ington, D. C.; Councillors, B. K. Emerson, Amherst, Mass., and J. M. Safford, Nashville, Tenn.

The newly elected Councillors replace E. A. Smith and C. D. Walcott who retire under the rules. The other members are F. D. Adams, I. C. Russell, R. W. Ells and C. R. Van Hise. The following fellows were also announced as elected :

Harry Foster Bain, B. S., M. S., Des Moines, Iowa, assistant geologist, Iowa Geological Survey.

William Keith Brooks, Ph. D., Baltimore, Md., professor of zoölogy in Johns Hopkins University.

Charles Rochester Eastman, A. B., A. M., Ph. D., Cambridge, Mass., assistant in paleontology in Museum of Comparative Zoölogy and in Harvard University.

Henry Barnard Kümmel, A. B., A. M., Ph. D., Trenton, N. J., assistant on the State Geological Survey of New Jersey.

William Harmon Norton, M. A., Mt. Vernon, Iowa, professor of geology in Cornell College, special assistant on the Geological Survey of Iowa.

Frank Bursey Taylor, Fort Wayne, Ind. Accountant, engaged in pleistocene geology.

Jay Backus Woodworth, B. S. Cambridge, Mass., instructor in Harvard University and assistant geologist on U. S. Geological Survey, engaged in general and glacial geology.

The Council also distributed a printed report containing the resumé of the year. The last printed roll contains the names of 223 living and 13 deceased fellows of the Society. Four have died during the year. The financial affairs of the Society are in good condition. After a few announcements, memorials of deceased members were presented as follows: of James D. Dana, written by Joseph Le Conte and read by H. S. Williams; of Henry B. Nason, written by T. C. Chamberlin and read by Bailey Willis; of Albert E. Foote, written by G. F. Kunz and read by J. F. Kemp; of Antonio del Castillo, written by Ezequiel Ordonez and read by the Secretary.

The reading of scientific papers was then taken up with the usual rule that papers whose authors were not present in person were passed and transferred to the end. The papers actually read came in the following order.

Illustrations of the Dynamic Metamorphism of Anorthosites and related Rocks in the Adirondacks. J. F. KEMP, New York, N. Y.

The high, central peaks of the Adirondacks and the larger outlying ridges consist of anorthosite, a coarsely crystalline rock that is nearly pure labradorite. Though described as norite in earlier reports, it is noticeably poor or entirely lacking in ferro-magnesian silicates. In the course of a fairly extensive reconnoissance of the principle portion of the mountains, the writer has met but limited exposures of the anorthosites in an uncrushed condition. Specimens of such were shown, and beginning with these as a starting point the gradual development of crushed rims was shown, which at first barely discernible, increased until the original crystals of labradorite were but small nuclei. The extreme is a 'pulp-anorthosite' with no nuclei. The passage into gneissoid forms, through augen-gneisses, and with a rich development of garnets, was also illustrated. The final result is a thinly laminated gneiss. Comments on the areal distribution of these types were added. The speaker then took up a series of basic gabbros and illustrated, by specimens, their passage into gneissoid types in the same exposure. Acknowledgments are to be made to Prof. James Hall, State Geologist of New York, under whose direction a part of the material used for illustration was gathered. The paper was discussed by A. C. Lane and C. H. Hitchcock, bringing out the facts that in the gabbros the change to gneiss was generally marked by a passage of pyroxene to hornblende, and that the igneous series, though called Upper Laurentian by the speaker in following the Canadian usage, was doubtless later than the crystalline limestones of the region, that would be called Algonkian by many American geologists.

The Importance of Volcanic Dust and Pumice in Marine Deposits. N. S. SHALER, Cambridge, Mass.

Considerations based on volcanic action in the Java district make it probable that the extrusions of rock matter in the form of dust and pumice may exceed that which is carried to the sea by the rivers and possibly equals that which is conveyed to the ocean by all other actions. Observations on the shores of the United States afford evidence that there is a noticeable contribution of pumice to the deposits forming along that coast line. The facts warrant the supposition that the value of these volcanic contributions to sedimentation has not been properly appreciated.

The paper elicited an extended and interesting discussion. C. H. Hitchcock, apropos of the recorded discoveries of pumice along the southern coast line of the United

States, stated that in his travels in the West Indies he had found no pumiceous rocks among the volcanoes, and suggested the possibility of remoter sources. C. W. Hayes remarked upon a vast formation of volcanic tuffs met by him in eastern Alaska, extending over many hundreds of square miles and up to 75 feet thick. Its bulk he estimated at over 100 cubic miles. He also referred to the top layer of the Devonian rocks of the southern Appalachians, which 8 inches to 18 inches thick, extends from eastern Tennessee and Georgia to Arkansas and Missouri, and which is regarded as a volcanic tuff. L. V. Pirsson mentioned the wide area over which the fine ejectments of Krakatoa had spread and gave a brief sketch of Bäckstrom's observations on the presence of volcanic dust in the sea beaches of Norway. Much of this is demonstrably from Iceland, but other samples agree with the products of no volcano in the Atlantic basin. Caution is needed not to be misled by artificial slags and cinders. M. E. Wadsworth cited the tuffs collected by S. Garman, G. P. Merrill and J. S. Diller in Nebraska, and by Diller in Massachusetts. Persifor Fraser called to mind the dust that was gathered by Joseph Wharton in Philadelphia on the first snowfall, December, 1883, Krakatoa having been active in August of the same year. Its microscopic characters agreed entirely with samples from Krakatoa.

The discussion then took up the length of time, during which such dust might remain suspended in the atmosphere. W. M. Davis stated that the peculiar red sunsets following the Krakatoa outbreak lasted through 1884, and that the so-called Bishop's ring was visible around the sun for fully two years. N. S. Shaler mentioned the observations of the Germans on shining clouds that were at first 80 miles in the air and that were later noted at 140 miles before they disappeared. He also reminded the Society that the same red sunsets followed the great eruption of Skaptar Jokul in 1783. C. H. Hitchcock raised the point that red glows from aqueous vapor should not be confused with colors from volcanic dust, as the latter are chiefly greenish, but in reply it was brought out that the colors were due to diffraction and that the reds might also be caused by fine particles of mineral matter.

A needed term in Petrography. L. V. PIRSSON, New Haven, Conn.

The speaker adopted the definition of a crystal that is based upon its outer plane faces, rejecting thus the tendency of some authors to make it dependent on internal, physical and optical properties. He then spoke of the inaccuracy of using the word crystal for the mineral components of a rock, which, in most cases, have no plane faces, illustrating his point by the augites of augitic rocks. For such the terms crystal fragment and crystalloid had been used, but were both objectionable. Therefore, after consultation with E. S. Dana, he proposed the name anhedrine for them, the word meaning without planes. In a brief discussion that followed, the term was on the whole well received, although the general feeling was strong against the introduction of further new terms into the over-burdened nomenclature of petrography and other branches.

Note on the Outline of Cape Cod. W. M. DAVIS, Cambridge, Mass.

The speaker described the topography of the Cape from a point some distance south of Highland Lighthouse, to the north, and made a distinction between the 'mainland outline' or the original glacial drift hills of the highlands, and the 'constructional outline' by which was meant the later added sandspit to the north. The argument was then made that the 'mainland' had once extended some miles to the southeast, that it had been worn away at first to a somewhat northwesterly coast line, now indicated by an inshore sandspit, in the constructional area, and later to a more northerly line as shown by the building of the present spit from the 'point of attachment' in sympathetic conformity to the cliff line on the south. The migration of the sediment worn from the cliff around the end of the point, the features of Race Point and Long Point and the crescentic scouring of the inner side of the cape, were all commented on. G. K. Gilbert asked if there is any evidence of the elevation or depression of the cape area *en bloc*, to which the speaker replied that there is none. C. H. Hitchcock recalled the idea of Louis Agassiz that there had once been a continuous line of drift from Cape Ann to the 'mainland' of Cape Cod, but the speaker said it had been long disproved, and referred also to historic records of islands off to the southeast of Highland Lighthouse. In closing the discussion President Shaler stated that the 'mainland' of the cape was formed by a deposit of drift on an old preglacial divide of Tertiary and Cretaceous strata, and that the former river systems could be traced with entire accuracy southward through Vineyard sound. He dwelt also on the fear of the Provincetown people lest the cape to the east of them should be breached and their harbor be filled with sand. The value of jetties north of the 'point of attachment' referred to above was emphasized.

The Society then adjourned until the following day at 10 A. M. Thursday evening many of the Fellows attended the interesting lecture of Prof. Wm. B. Scott on the Tertiary Lake Basins of the West, at the Philadelphia Academy of Sciences, and all who are accustomed to arc-light stereopticons were strengthened in their faith in them, as the lime light provided did not do Prof. Scott's slides justice. Nearly all the Fellows also attended and enjoyed the reception which was most hospitably extended to the visiting societies by Dr. Horace Jayne, to whom an expression of thanks is due.

The Council of the Society met at 9 A. M. Friday and transacted routine business. At 10 the Society assembled and devoted a few minutes to executive business. The auditing committee and the committee on photographs reported. The latter placed on exhibition the collection which now amounts to 1283 pictures, many of which are of more than ordinary interest. 205 new ones were added during the year. Great credit is due the efficient chairman of the committee, Dr. Geo. P. Merrill, of the United States National Museum, for his efforts in its behalf. The committee solicits donations which may be sent to Dr. Merrill and which will be duly acknowledged in the publications of the Society. The Society also voted not to have a session separate from Section E of the American Association at the summer meeting, but only one for executive business and for the reading of papers by title. Attention will also be given to arranging excursions as heretofore. Fellows of the Society are urged to read their papers in Section E, while publishing as before in the *Bulletin*. It was announced that a group photograph would be taken at the noon recess. This was afterward done, with a quite successful result, by Herbert Hoffman, of 914 Arch street, Philadelphia. The business finished, the Society listened to the annual presidential address. It was delivered by retiring President Shaler, and will appear in full in an early number of SCIENCE. The subject was 'The Relations of Geologic Science to Education,' and it was followed by some discussion by Messrs. Gilbert, H. S. Williams and Wadsworth. The regular papers were then taken up as follows:

Plains of Marine and Subaërial Denudation. W. M. DAVIS, Cambridge, Mass.

Ramsey's explanation of plains of abrasion as the product of marine denudation

(1847) found general acceptance, and in England to this day hardly any serious consideration is given to any other explanation. The production of plains of abrasion at the completion of a cycle of subaërial denudation, advocated by Powell in connection with the idea of the baselevel of erosion (1875), has found wide acceptance in this country, but it is less approved abroad. The paper considered the criteria by which plains of abrasion of one origin or the other may be distinguished. When such plains are uplifted and maturely dissected in a second cycle of denudation the difficulty of determining their origin increases. It is suggested that plains of subaërial denudation may be recognized, even when uplifted and dissected, by the degree of adjustment of their streams to their structures; thorough adjustment requires a longer time of stream action than has passed since uplift; much of the adjustment must be referred to a previous cycle of denudation, which is thus shown to have been a subaërial cycle.

Considerable discussion followed by Messrs. Willis, Reid, Hayes, Van Hise and Gilbert, the speakers giving instances from different parts of the continent, which illustrated one or the other interpretation cited, or which emphasized the large part played by the character of the rocks concerned or by isostatic adjustments.

Cuspate Fore-lands. F. P. GULLIVER, Cambridge, Mass.

1. Action of waves, tides and currents. Waves attack the whole coast, but erode more rapidly on headlands than at bay heads. Tides are less effective agents of transportation along shore on exposed coasts than currents, but they are the important agents in sounds, channels and inlets.

2. Current cusps. Type, Cape Hatteras. The cusp is formed in the dead water between two eddy currents.

3. Tidal cusps. Type, West Point, Puget Sound, Washington. The cusp is formed between eddies of in- and out-flowing tides.

4. Delta cusps. Type, Tiber delta, Italy. The mouth of the river forms the point of the cusp, on either side of which the along shore currents arrange the detritus.

The paper was illustrated by pilot charts, which somewhat unfortunately were not all used, as space for display was limited. Bailey Willis remarked on the applications of the views advanced to localities in the Puget sound region.

Drainage Modifications and their Interpretation. M. R. CAMPBELL, Washington, D. C.

This paper opened with a discussion of the subject of stream modification under the influence of slow elevation or depression of the earth's surface. From this was derived the Law of the Migration of Divides which control, to a greater or less extent, the alignment of all drainage systems. The Law of the Migration of Divides is in brief that divides migrate toward a region of uplift and away from a region of depression. The relations of divides may therefore be significant indicators of the lines of upheaval or depression even when these are comparatively slight. Criteria were given by which these modifications may be recognized and the character of the crustal movement determined.

A brief description followed of some of the drainage systems of the Appalachian province, south of the glaciated region, to show that similar modifications of the drainage are of common occurrence, not only in the regions of horizontal rocks, but also occur in the highly complicated geologic structure of the Appalachian valley. It was shown that some of these changes are of recent occurrence, whereas some probably date back to the time of the Jura-Trias depression.

The principal object of this paper was to show that the drainage of the Appalachians constitutes a record of Mesozoic history, and that this record is to the physiographer of equal importance with that contained in the forms sculptured from the surface of the land.

In the discussion President Shaler took up the relations of the drainage systems of Kentucky and emphasized the value of the paper in helping to clear away points that were previously obscure. Remarks by Messrs. Davis and Gilbert followed, and the latter in reply to a question alluded to the part played by the rotation of the ear th in determining lines of drainage. He described it as slight, if at all present, and as requiring almost unattainable delicacy of tests for its detection.

Some Fine Examples of Stream Robbing in the Catskill Mountains. N. H. DARTON, Washington, D. C.

By means of a large topographical chart the speaker showed how the Kaaterskill and Plaaterskill Creeks flowing eastward into the Hudson, had pushed their divides backward until they had robbed the headwaters of Schoharie creek. Other small ones along Esopus creek were also cited.

Movement of Rocks Under Deformation. C. R. VAN HISE, Madison, Wis.

The paper was a general discussion of the behavior of rock when subjected to deforming stresses, and is preliminary to the discussions which the author gave last summer on the analysis of folds and upon the relations of primary and secondary structures in rocks.

Three zones in the earth's crust were cited: 1, an outer one of fracture during rock movement; 2, an inner one of mixed fracture and flowage; 3, an inmost one of flowage. In elaborating these, the effects of pressure on rocks were analyzed. It was shown that a quick application of pressure might fracture where a slow one would cause flowage, and that the possible depth at which cavities might exist was greater than had been assumed by Heim (5000 m.). Mathematical deductions by Prof. Hoskins, of Stanford University, made for this paper, have shown that where the walls of a cavity are subjected to three equal stresses at right angles with one another, the cavity will be closed up in case the stresses equal two-thirds the ultimate strength of the rock. With a single stress the full crushing pressure is needed. Assuming the strongest rock for these conditions in order to get a certain maximum depth below which cavities would be an impossibility, and taking the specific gravity of the crust at 2.7, from which in the calculation we must subtract 1, for the water that penetrates all fissures, we obtain for the first relation of forces 6670 metres and for the second 10,000 metres as this depth. Under these conditions the water is understood to be free to escape. Instances of quartz pebbles were cited, one being rolled out without fracture in the Marquette region. The effects upon heterogeneous rocks were discussed and their relations to folding. The zone of mixed crushing and folding was next taken up, after which the paper concluded. In the discussion A. C. Lane spoke of the bearing of the paper on the conceptions advanced by him at a previous meeting regarding the escape of the earth's internal gases. J. F. Kemp referred to its important bearing on the origin and possible depth of formation of mineral veins. B. K. Emerson cited the case of the Cambrian gneisses of Massachusetts, in which quartz crystals are rolled out as thin as paper, but with their optical properties unimpaired, and emphasized the possibility of chemical recrystallization. J. P. Iddings brought up the interesting experiments of O. Mügge on ice crystals as recently set forth in the Neues Jahrbuch, showing that ice sheared in small blocks along gliding planes across the optic axis without altering its direction. Prof. Van Hise in closing admitted the possibility of chemical recrystallization, citing in illustration some marbles which exhibited it, but mentioned others that are full of strained and crushed crystals. The paper was one of the most important of the meetings and is indispensable to all students of metamorphic districts.

Proofs of the Rising of the Land around Hudson Bay. ROBERT BELL, Ottawa, Canada.

The speaker cited well preserved sea margins and grand terraces, especially on the eastern coast; lines of driftwood above highest tides; debris along old shore lines in the woods on the west side at a distance from the highest tides; islands near shore becoming peninsulas within the human period; drying of salt water marshes; the character of the lower parts of streams showing recession of the sea; shoaling of mouths of rivers and formation of new islands and bars in historic times; other historic evidence; successive growth of marsh plants, bushes, poplars, spruces, etc., as the land rises; beach dwellings and other shore works of the Eskimos now elevated to considerable heights; fresh character of fossil shells, etc., in clays and sands; deep water deposits elevated above the sea level at comparatively recent periods; similar phenomena on the eastern coast of the Labrador peninsula; bones of whales, etc., on elevated ground in Hudson Strait; raised terraces and beaches in the northwestern part of Hudson Bay; general shoaling of the water, extension of shores and enlargement of islands.

The paper was discussed by one or two speakers without, however, bringing out material points.

Possible Depth of Mining and Boring. ALFRED C. LANE, Houghton, Mich.

This paper discussed some of the difficulties in deep mining, especially the rise in temperature, and considered what the most favorable circumstances are and the most effective way of overcoming the difficulties, and how far we may expect that the earth's crust will be penetrated. The expenses were plotted as the abscissas of a curve of which the depths furnished the ordinates. Ten thousand feet appeared to be approximately the limit. The depths of some of the shafts in the copper country of Lake Superior were cited, and the hope was expressed that, when the ultimate practical depth has been reached, a purely scientific bore hole be started at the bottom, before the shaft is abandoned, and sent down several thousand feet further. In the discussion that followed special attention was paid to the rate of the increase of temperature as we go down. One speaker cited the recent results published by Alexander Agassiz in the American Journal of Science, December, 1895, p. 503, as 1° F. for each 223.7 feet down to 4,580. For this result a mean rock temperature at 105 feet of 59° F. is used, whereas the mean annual temperature of Calumet is about 40°, and practically this temperature of 40° has been determined at slight depths in other neighboring mines. A mean annual temperature of 59° F. is not met north of Kentucky and this fact makes corroboration desirable before important inferences are based on the later and excessively low gradients.

Notes on Glaciers. HARRY FIELDING REID, Baltimore, Md.

Dr. Reid referred, in opening the paper, to his recent efforts to get reliable data on the variations of American glaciers. Mr. Willis reports that the Pyallup glacier on Mt. Rainier had retreated 200–300 yards and the Carbon glacier 100–200 feet. In British Columbia the Illicilliwaet was observed to recede in 1890 and 1894. Dr. Reid then gave a most interesting analysis of the accumulation and motion of glaciers. He distinguished the region of accumulation of snow in excess of melting as the reservoir, and the region of melting in excess of accumulation as the dissipator; the border line is the nêvé line. By assuming cross-sections at various points, the relative velocities of movement were worked out on the basis of mechanics. The same was done for a glacier which spreads from a center in all directions. The progress of the same layer of snow was then traced from reservoir to dissipator and parallel lines of motion for the individual parts were established, the névé line furnishing a middle line. It was then shown that the original stratification plane as indicated by debris would at the end of the journey cut these lines of motion and would emerge with a high dip, a fact already observed on some glaciers. The topic of the variation in the advance and retreat of glaciers was discussed and the several explanations were analyzed in detail. The paper was discussed by G. Frederick Wright and R. D. Salisbury, the latter mentioning that the thin fronts of Greenland glaciers showed the upward tendency of stratification planes, but that thick fronts lacked it. The Society then adjourned until the following day.

In the evening about sixty Fellows dined together, with President Shaler and Professor Emerson acting jointly as toastmasters, and listened to some amusing speeches by several members.

On reassembling Saturday morning the reading of papers was at once resumed.

The Relation between Ice Lobes South from the Wisconsin Driftless Area. FRANK LEVERETT, Denmark, Iowa.

Instead of a coalescence of ice lobes from the east and the west sides of the Driftless Area in the drift-covered district to the south there was an invasion and withdrawal of one lobe (the western) before the other reached its culmination. The eastern lobe encroached upon territory previously glaciated by the western, depositing a distinct sheet of drift and forming at its western limits a well-defined morainic ridge. There appears to have been a period of considerable length between the withdrawal of the western lobe and the culmination of the eastern.

Subsequently, however, there was a readvance of the lobe on the west into northeastern Iowa, and this readvance appears to have been contemporaneous with the nearly complete occupancy of northwestern Illinois by the eastern ice lobe. It seems not improbable that the ice lobes were then for a brief period coalesced for a short distance about the south border of the Driftless Area. Evidence of complete coalescence, however, is not decisive so far as yet discovered.

These developments serve to throw light upon the cause for the scarcity of lacustrine deposits in the Driftless Area. They show that there was at most but a brief period in which the southward drainage of the Driftless Area was completely obstructed by the ice sheet.

By means of maps it was brought out that there were probably two centers of accumulation—one, the earlier, toward the northwest; and the other, the later, in the Labradorian heights. In the discussion R. D. Salisbury remarked the great complexity of the glacial period, and G. Frederick Wright, while admitting the minor complexity, emphasized its essential grand unity. President Shaler called attention to the importance of demonstrating the progress of glaciation from west to east, because if we can establish the sequence of events, we have advanced a long way toward discovering their cause.

The Loess of Western Illinois and Southeastern Iowa. FRANK LEVERETT, Denmark, Iowa.

The north border of the loess both in

western Illinois and eastern Iowa appears to have been determined by the ice sheet. The loess is apparently an apron of silt spread out to the south by water issuing from the ice sheet. It is loose textured at the north and becomes finer textured toward the south, showing a decrease in the strength of depositing currents. The wide extent of loess over the uplands has led to a consideration of the influence of wind as well as water in its distribution. It is thought that wind-deposited loess may be distinguished from that which is water deposited. The wide extent, however, appears to be due to water distribution rather than wind. Wind action apparently came into force subsequent to the water distribution and is of minor importance.

G. K. Gilbert in discussion expressed his gratification at hearing of 'loess' the rock, instead of exclusively of 'the loess,' the peculiar geological formation. He cited a case in eastern Colorado, along the Missouri Pacific Railroad, where loess had gathered on the leeward side of sand dunes. B. K. Emerson spoke of the aqueous loess of the Hadley meadows in Massachusetts from the annual floods of the Connecticut river, and the eolian loess on the neighboring hills.

High-level Terraces of the Middle Ohio and its Tributaries. G. FREDERICK WRIGHT, Oberlin, O.

This paper embodies the results of the writer's personal observations during the summer and autumn of 1895 on the terraces of the Ohio river, between Steubenville and Marietta, and on the Kentucky river, between High Bridge and Boonetown. The presence of beds of granitic gravel and of isolated boulders of this rock, *i. e.*, of a rock that must have reached its resting place by the agency of ice from the north, in the country adjacent to the Ohio was remarked. An elevated and extensive bed of sand on the southwest end of a large island between St. Mary's and Newport was instanced as indicating peculiar and as yet not well explained conditions of high water and of a change in the river channel.

I. C. White in discussion explained the large island as in large part caused by a preglacial channel of Middle Island creek, which enters the Ohio at St. Mary's, directly athwart its course and through a gorge that is continued in the abandoned channel that now forms the island's northwest side. He also stated that pebbles often reached exceptional heights on the hills because the farmers use sand with some contained gravel for bedding in their stables and consequently scatter it over their fields at all altitudes. President Shaler also cited the custom among the Indians of cooking with heated boulders, and as the local limestones and sandstones were of no value for this purpose they often brought granitic boulders from a distance. Prof. Wright, however, cited boulders of 4,000 pounds, which manifestly could not be explained in these ways. A. Heilprin then mentioned the polished and grooved rocks of South Africa which had been regarded as glaciated. More careful investigation however has shown that the polishing is due to the habit of elephants to formerly resort to them and roll and scrape on them, and that the grooves are due to the rubbing of their tusks. F. Leverett corroborated the observations of Prof. Wright in the northern part of the area.

Four Great Kame Areas of Western New York. H. L. FAIRCHILD, Rochester, N. Y.

This paper described three kame areas south of Irondequoit bay and one south of Sodus bay. These are remarkable for extent and quantity of material, as well as for location and altitude; one of them having gravel hills 400 feet high and furnishing the highest altitude of ground in western New

York, north of the Devonian plateau. The geographical location and extent of the kames were shown by a large map and the first three were named, the Irondequoit, the Mendon and the Victor; the last was called the Junius. Excellent photographs were passed around in further illustration.

Paleozoic Terranes in the Connecticut Valley. C. H. HITCHCOCK, Hanover, N. H.

The author has made occasional studies of the rocks along the upper Connecticut valley since his official connection with state surveys, and thinks there are good reasons for revising some of the conclusions of the New Hampshire report. Some of the points are: 1. The existence of two bands of argillite; one below and the other above the calciferous mica schist. 2. The hornblende schist of the neighborhood of Hanover is a laccolite. 3. The protogene gniesses of Hanover and of North Lisbon are igneous. 4. With the views now entertained of the igneous origin of the protogene, hornblende schist, foliated diorites and diabases, a new arrangement of the stratified fossiliferous rocks of Littleton, N. H., is suggested. The points were illustrated by geological maps. The older argillite cited under 1, above, was referred to the Upper Silurian, and the later one to a subsequent but not definitely determined period. The discovery of contact effects along the junction of the hornblende schist of 2, with the argillites and mica schists is additional ground for the later conclusion. In support of 3, it was shown that the gneiss contains inclusions of the schists. Under 4 the metamorphic rocks, in association with fossiliferous Niagara limestone at Littleton, are now regarded as post-Niagara, not Cambrian. B. K. Emerson, in discussion, remarked that this revision placed the geological structure in harmony with the results now attained in Massachusetts on the south.

The next paper was by C. Willard Hayes on 'The Devonian Formations of the Southern Appalachians.' Mr. Hayes gave a generalized section of the Devonian as follows: An upper and very persistent layer, 8 inches to 24 inches thick, of a green sandstone, with phosphatic nodules and shreds of volcanic glass, feldspars, etc., such as to indicate a volcanic tuff. Below this comes black shale, 0–12 ft., and not always present. The bottom stratum is a ferruginous conglomerate or sandstone 0–6 ft., and contains the recently discovered phosphate beds of Tennessee. Attempts to explain the thin character or actual absence of the Devonian over great areas have been made as follows.

1. The region was a deep sea bottom, lacking sediments.

2. It was a region of shallow waters whose entering streams were without sediments.

3. It was a land area.

4. It was a shallow sea without sediments and with swift but clear currents, like the Gulf stream region of the West Indies.

The speaker believed, however, that such sediment as was distributed came in large part in currents from the northeast, and that another current came from the southeast and moved northwest, rounding the Cincinnati arch. D. W. Langdon raised the point of the relations of the Devonian to the Helderberg limestones in southwest Virginia, and the same point was discussed by the author and by J. J. Stevenson. Messrs. Keith, Van Hise and H. S. Williams also took part in the discussion.

Notes on the Relations of the Lower Members of the Coastal Plain Series in South Carolina. N. H. DARTON, Washington, D. C.

The formations below the Eocene buhrstone which were included in the Eocene by Tuomey have been found to be Potomac. Some of their features and their relations to the marine Cretaceous were described.

Resumé of General Stratigraphic Relations in the Atlantic Coastal Plain from New Jersey to South Carolina. N. H. DARTON, Washington, D. C.

A series of sections were exhibited to show the distribution and variations of the principal coastal plain formations, and there were pointed out some bearings of the features on the geologic history. The data are based largely on the author's studies, but they also combine a resumé of some observations of others.

Both these papers were read together and were illustrated by figured geological sections based on the recently acquired records of artesian wells. There were five, viz: Philadelphia to Wildwood, N. J.; Washington to Crisfield, Md.; Richmond to Norfolk; Orangeburg to Charleston; Aikin to Beaufort, S. C. They illustrated the relations of the granitic Archean rocks to the Jurassic Potomac formation, the Cretaceous Magothy and Severn, the Eocene Pamunkey and the Miocene Chesapeake. Paleontologic details would have made the first paper clearer. An interesting and important point is the discovery of Newark sandstone in a deep well at Florence, S. C., far south of our previously recorded locations. D. W. Langdon, in discussion, raised the paleontologic point referred to above.

The last paper read was by Arthur Keith, '*Some Stages of Appalachian Erosion.*' The paper was a general review of the drainage systems of the area in question, and of the factors which had contributed to develop its present topography.

C. H. Hitchcock then presented a resolution of thanks to the local committee and to the authorities of the University of Pennsylvania for their hospitality and many courtesies. It was unanimously passed and then the eighth annual meeting of the Society adjourned.

The following papers, although announced in the program, were not read either because their authors were absent from the meeting, or because they were not present when the papers were reached in regular order:

The Natchez Formations. T. C. CHAMBERLIN.

Disintegration and Decomposition of Diabase at Medford, Mass. GEORGE P. MERRILL, Washington D. C.

On the Geographic Relations of the Granites and Porphyries in the Eastern Part of the Ozarks. CHARLES R. KEYES, Jefferson City, Mo.

The Cerrillos Coal Field of New Mexico. JOHN J. STEVENSON, New York, N. Y.

Pre-glacial and Post-glacial Channels of the Cuyahoga and Rocky Rivers. WARREN UPHAM, St. Paul, Minn.

J. F. KEMP.

COLUMBIA COLLEGE.

AMERICAN MORPHOLOGICAL SOCIETY.

OF the three sessions held by the Morphological Society the first was mainly devoted to business questions, of which the most important related to the plan of affiliation with the Society of Naturalists brought forward at the meeting of 1894. This plan was rejected on the ground that most of the other societies had taken action adverse to it. It was, however, recommended that coöperative action by all the societies should be urged in order to assure a common place and time of meeting. A resolution was adopted endorsing the action of the Smithsonian Institution in maintaining an American table at the Zoölogical Station at Naples, and expressing the earnest hope of the Society that the table may be continued in order that the unrivalled facilities of the Station may be open to American investigators in the future as in the past.

The scientific program was as follows:

Friday, December 27, 1895.

C. S. Minot: *Panplasm.*

B. B. Griffin: *The History of the Centrosome in Thalassema.*

E. B. Wilson: *The Centrosome in its Relation to Fixing and Staining Agents.*

T. H. Morgan: *The Production of Artificial Archoplasmic Centers.*

F. R. Lillie: *On the Smallest Parts of Stentor Capable of Regeneration.*

E. G. Conklin: *Cell-size and Body-size.*

T. H. Morgan: *The Development of Isolated Blastomeres of the Egg of Amphioxus.*

G. W. Field: *Spermatogenesis of Amphioxus.* (By title only.)

Saturday, December 28, 1895.

Bashford Dean: *Gastrulation of Teleosts.*

W. A. Locy: *Further Evidence of Primitive Metamerism in Birds and Amphibia.* (By title only.)

G. H. Parker: *Pigment Changes in the Eye of Palæmonetes.*

G. H. Parker: *Reaction of Metridium to Food and Other Substances.*

C. W. Stiles: *Some Points in the Anatomy of Anoplocephaline Cestodes.*

R. P. Bigelow: *Development of Cassiopea from Buds.*

A novel feature of the scientific sessions was the grouping of allied papers, a plan which proved very successful as a stimulus to general discussion. The first session was entirely taken up with papers on protoplasm, the cell and the closely related subject of experimental embryology. Professor Minot, of Harvard, opened with a paper on 'Panplasm,' in which the nature of protoplasmic organization was critically discussed. The doctrine now advocated by so many cytologists, that protoplasm is compounded of elementary organic units, such as the 'pangens of de Vries, the 'idioblasts' of Hertwig, the 'biophores' of Weismann, etc., was rejected *in toto*. Protoplasm, he maintained, is a mixture of substances, not of self-propagating units; and the attempts to distinguish between living substance and the 'lifeless' substances associated with it are, in the main, wide of the mark. The entire substance of the cell, the 'panplasm,' is the only real unit and must be regarded as a whole.

Mr. Branley B. Griffin (Columbia) described the fertilization of the egg and the history of the centrosome in the gephyrean worm, *Thalassema*. As in echinoderms and many other forms there is no 'Quadrille of Centers.' The centrosome of fertilization is derived from the supermatozoön and the egg-centrosome degenerates after the formation of the polar bodies. The sperm-centrosome may be continuously traced, as a distinct black granule, throughout all the stages of fertilization into the cleavage-stages, and at no time disappears. The centrosome of the first spindle becomes double at a very early period and passes to the outer periphery of the centrosphere, where a minute amphiaster is formed on each side as early as the mid-anaphase of the first cleavage. This amphiaster is the precocious preparation for the second cleavage.

Prof. E. B. Wilson (Columbia) called attention to the fact that the existing confusion regarding the centrosome and attraction sphere is probably due in part to the varying effects of reagents on these structures. In *Thalassema*, as shown by his own observations and those of the preceding speaker, the centrosome appears as a minute black granule after hardening with sublimate or picro-acetic and staining with iron hæmatoxylin. After sublimate-acetic neither centrosomes nor deutoplasm spheres stain, though the general fixation is not inferior to that yielded by the other methods. This suggests the possibility that in *Toxopneustes*, likewise, the sublimate-acetic mixture may cause the centrosomes to disappear from view. It was however recalled that in certain stages of this same form they are not shown after other reagents, such as sublimate and Hermann's fluid; that they are perfectly shown in the maturation spindles of the starfish after sublimate-acetic, but afterwards disappear; and that Hill's observations (sublimate-acetic) and Boveri's (picro-acetic) differ both from each other and from the speaker's. The whole subject, therefore, requires further study with special reference to the technique.

The following paper by Prof. T. H. Morgan (Bryn Mawr), on the production of artificial archoplasmic centers, was of special interest and led to much discussion. Unfertilized, as well as fertilized, eggs of sea urchins and ascidians, when treated with salt solutions of a certain concentration, become filled with numerous asters which show in many respects a close resemblance to the normal asters of dividing cells, and may contain a body similar to a centrosome. This cannot be due to polyspermy, because the eggs contain but a single nucleus, and for other reasons. Prof. Morgan is inclined to regard the asters as new formations produced by a rearrangement of the protoplasm under abnormal conditions. In a second paper Prof. Morgan described the development of dwarf larvæ from isolated blastomeres of *Amphioxus*, with reference to the numerical relations of the cells. Half-larvæ and quarter-larvæ always possess a number of cells not precisely one-half or one-quarter the normal number of the full sized animal at the same stage but somewhat greater, and these partial larvæ show a marked tendency, not however fully carried out, to use the same number of cells in the formation of their organs as that used by the full sized larva. Thus the notochord is always formed of three cells (in cross-section) in larvæ of all sizes. These results show that there is an inherited tendency to produce a definite number of cells for the formation of particular organs, irrespective of the total size of the embryo.

The paper of Prof. Conklin (University of Pennsylvania), on 'Cell-size and Body-size,' discussed a nearly related question from a different point of view. Observations on the marine gasteropod, *Crepidula*, show that adult animals vary enormously in size, the dwarfs having in some cases not more than $\frac{1}{25}$ the volume of the giants. The eggs are, however, always of the same size and are proportional in number to the size of the adult. Microscopical study of the tissues shows that the same is true of the tissue cells. Measurements of cells from various tissues, representing derivatives of all the germ layers (ectodermal epithelia, kidney cells, liver cells, alimentary epithelia, etc.), show that they are not perceptibly smaller in the dwarfs than in the giants. Prof. Conklin, therefore, concludes that body size is not dependent on cell size, but on the total *number* of cells, a result which agrees with that reached by botanists, but differs somewhat from that obtained through a study of the nervous system in higher animals. His conclusion agrees only in a measure with Morgan's results on *Amphioxus;* for the latter indicate that the number of cells in dwarfs, while considerably less than in those of normal individuals, is not strictly proportional to the body size.

Dr. Lillie (University of Michigan) presented the results of a research on the limit of size in the regeneration of *Stentor*. These animals, like eggs, may be shaken into fragments of various sizes, among which may be found both nucleated and non-nucleated pieces and also naked nuclear fragments. Only such fragments as contain both cytoplasm and nuclear substance are capable of regeneration. Complete regeneration may take place in a fragment containing only 1-27 the bulk of an entire animal. Smaller fragments cannot regenerate. This result is remarkably near to that of Boveri, who has found that the limit of size in egg fragments capable of producing a complete larva (in sea urchins) is approximately 1-20 the volume of the entire egg.

The second session was devoted in the main to papers on anatomy and development, varied by physiological contributions from Dr. Parker.

Dr. Dean (Columbia) discussed the gastrulation of teleosts from a comparative point of view, urging that a key to its interpretation must be sought in the development of ganoids. Lepidosteus, Acipenser and Amia form a progressive series culminating in the teleost, the length of the neural plate gradually increasing from 90° to more than 200°, the ventral lip of the blastopore becoming less clearly marked, and the neural plate becoming more and more concentrated towards the median plane. The following interpretation of the of the parts of the teleostean gastrula was adopted: dorsal and ventral lip of the blastopore as identified by Haeckel, Ryder, H. V. Wilson and others; 'ventral mesoblast' of H. V. Wilson as entoblast; Kupffer's vesicle as the notch under the dorsal lip of the blastopore, caused mechanically in the growth of the Randwulst; periblast as the highly differentiated outer layer of the yolk mass, which enables the enclosing growth of the blastoderm, yet preserves in a most perfect way its incremental relations with the adjacent tissues of the embryo. In view of the presence of medullary folds in Lepidosteus and Acipenser, rudimentary in the former, perfect in the latter, the solid neural plate of the embryonic Teleost must be regarded as a secondary condition, due to the mechanical needs of the embryo in its precocious growth.

Dr. Parker's (Harvard) first paper considered the pigment changes in the eye of the shrimp *Palæmonetes* with especial reference to the nature of the reflex-action involved.* The pigment-changes called forth by the action of light take place in the typical manner in animals after section of the optic nerve, showing that they are not determined by a reflex center in the cerebral ganglia, but by a local action which may be due to the direct action of light on the pigment cells.

In his second paper Dr. Parker gave an account of experiments on sea anemones which led to interesting results. These animals respond in a definite manner either to solid or dissolved food matters, and the sense by which they are perceived resides in the tentacles, the oral disc and the lips of the mouth. Food is taken in through the action of cilia covering the tentacles and the entire oral region. Those of the lips and œsophagus work inwards; those of the tentacles work outwards towards the lips. If nutritious substances are placed on the tentacles the latter bend inwards towards the mouth, into which the food is therefore swept by the cilia; innutritious bodies, on the other hand, cause the tentacles to be extended so that such bodies are carried out to the tips and thrown off. The most interesting results relate to the reversal of the ciliary action that occurs under certain conditions. Inert substances, such as carmine, may be at first swept into the mouth, but are afterwards thrown out by a reversed action of the œsophageal cilia. The action of the cilia is therefore under the control of the animal, which is moreover capable of certain degree of education. If animals be fed with fragments of meat and pieces of paper soaked in meat juice, both are at first taken into the stomach, but the paper fragments are afterwards thrown out. After a number of trials (seventeen or more) the animal learns to discriminate, the paper being rejected and the meat swallowed. Their memory is however short lived, for on the following day the lesson must be learned anew.

Dr. Stiles, of Washington, discussed a number of new points in the anatomy of tape worms, and exhibited a large number of plates of new and little-known species. He

* Unfortunately an adequate review of this paper cannot be given.

distributed specimens of Demodex and Coccidium parasites for class work, and made a plea for a more adequate study of parasites in college work as a preparation for medical studies.

Dr. Bigelow (Institute of Technology) described observations on the budding of the scyphistoma of Cassiopea, which tend to uphold the views of Claus and are opposed to those of Götte. The bud forms in the plane of one of the principal radii as an evagination of both layers. It is set free as a ciliated free-swimming planula and the mouth is afterwards developed, not at the distal, but the proximal or basal end. No stomodæal invagination of ectoderm occurs, and the proboscis is therefore lined by entoderm. The gastric pouches do not arise as evaginations, but by the inward growth of septa from the mesoglœa. The first tentacles to be formed are the four per-radial; the numbers in following stages are normally 8, 16 and 32.

CURRENT NOTES ON PHYSIOGRAPHY.

TOPOGRAPHICAL MAP OF ITALY.

FOUR sheets (Nos. 7, 18, 33, 46) of the topographical map of Italy—1 : 100,000—published recently by the *Istituto geografico militare*, cover a stretch of country from the crest of the Alps in the Bernina group, with many glaciers, to the northern side of the plain of the Po, where the river Adda emerges from the foothills. The northernmost sheet includes the divide between the Maira and the Inn, separating the waters of the Po and the Danube; here the northward migration of the divide, as described by Heim, has caused the formation of the little lakes of the Engadine (Die Seen des Oberengadin, Jahrb. Schw. Alpenklub, XV, 429); certain back-handed branches of the Maira, once tributaries of the Inn, are clearly shown. The second sheet exhibits the deep longitudinal valley of the Adda about Sondrio, 2,000 meters beneath the mountains on either side, the stream being continually thrown to one or the other side of its well-graded floor by the large alluvial fans of lateral streams. The two southern sheets show a number of torrential streams with tangled channels flowing southward in almost parallel courses across the great alluvial plain, whose slope is here about twenty feet to the mile; the banks of the streams often being somewhat higher than the ground between them, and thus indicating that portions of the plain consist of numerous alluvial fans, confluent laterally; a form very well adapted to the construction of the numerous canals that are led from the streams to the fields. The maps being printed in a single black impression, it is often difficult to distinguish streams and canals from roads.

MAP OF THE GERMAN EMPIRE. 1 : 1,000,000.

SEVERAL interesting features appear on certain sheets of the German topographical map, published last year and this. One of the broad dry valleys cut in the Piedmont slope of Bavaria by some extinct glacial streams, is exhibited on the Mindelsheim (636) and Burgau (622) sheets. The tangled channel of the torrential Inn and a glimpse of the shallow canyon of the Danube below Passau are found on the Neuhaus-a-Inn, sheet (628). Further up stream the Inn manifests a peculiarly strong tendency to follow the right-hand side of its broad valley floor, here at least two miles from side to side (Landau sheet 612). The great north-facing Jurassic escarpment of the Swabian Alp in Wurtemburg, is in part shown on the Aalen sheet (592), east of Stuttgart; the location of Aalen at the northern base of the escarpment, and of the road and railroad southward across the Alp from it, depend on the occurrence there of one of the several notches in the rim of the upland, representing the trough of a beheaded river, whose winding lower course on the southern slope of the Alp gradually gathers a little stream, the Brenz, as appears on the next sheet (607). Railroads crossing the Alp at Geislingen and Ebingen. further southwest, are similarly located; thus exemplifying the principle announced by Oldham (SCIENCE, II., 688). There are three sheets, 559, 574, and 590, of somewhat earlier issue on which the deep-incised meanders of the Neckar and its abandoned loops are beautifully portrayed.

TOPOGRAPHICAL MAP OF DENMARK, 1:100,000.

THE beautiful sheets of this series, printed in six colors for different soils and cultures, with most delicate expression, have comparatively little of importance to show of the flat inland topography, but exhibit many interesting coastal outlines.

On the inland waters of Limıjord (Lögstör sheet), the shore frequently swings in curves of small radius or projects in fine sharp spits, appropriate to the easy turning of litoral currents of small volume and strength; but on the exposed coast of the west and north, facing on North sea, the shore is modulated in long sweeping curves, adjusted to the slow swinging of the larger bodies of water there in movement. The Thisted sheet and others of previous issue as far north as Skagen, contain many examples of this kind. This recalls the different scale of meanders adopted by small brooks and large rivers. The *offset*, or outstanding position of one stretch of shoreline with respect to the next, may be taken to indicate the up-stream portion of the prevailing litoral current; this feature also being neatly shown on the North sea coast of the Thisted sheet, where the current seems to come from the southwest. Along the eastern coast, a north-to-south movement is implied by the offset of the coast north of the outlet of Limfjord compared to that on the south (Aalborg sheet); and this is clearly confirmed by the long sandbar of Stensnæs near by, tangentially overlapping southward (Frederikshavn sheet).

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE ETHNOLOGY OF MADAGASCAR.

THE occupation of the island of Madagascar by the French, in the year 1895, led to the publication of a number of articles on the history, languages and ethnology of the island. The two which I have found most instructive are one in the *Revue Scientifique*, by Prof. E. T. Hamy, 'Les Races Humaines de Madagascar,' and one in the Journal of the Anthropological Institute, by J. T. Last, 'on the languages of Madagascar.'

It is gratifying to find that both agree on the main question involved—the relationship of the oldest historic inhabitants of the island. This is distinctly *not* African, as many have supposed; nor is it Arabic, as some have argued; but it is 'Indonesian,' or 'Malayo-Polynesian,' that is, the earliest known possessors of the soil came from Malasia and Melanesia, and belonged to the so-called 'brown race.' Their language to this day is strongly affined to the Malayan; and this is true not merely of the dominant Hovas, but of the mass of the people. For about a thousand years, however, there has been a constant importation of negroes from Africa, and an arrival of colonists from the northern Semites; and these two admixtures have deeply tinged the blood of the stock.

PRE-GLACIAL MAN IN ENGLAND.

PROFESSOR Joseph Prestwich has lately published a volume entitled 'Collected Papers on some Controverted Questions in Geology' (London, 1895). Two of these papers have a deep interest for the anthropologist, one on the glacial period with reference to the antiquity of man in western

Europe; the other on the primitive flint implements found in the gravels on the chalk plateau of Kent. Although they both appeared before, they have now been published with additions.

Their conclusions may be briefly stated. The author thinks man probably lived on the Thames and the Somme in pre-glacial times, a period he would put at 30,000 to 50,000 years ago. The worked flints of the plateau—generally small, extremely rude and never 'compound' (*i. e.*, used with handles)—he attributes to these early men. Numerous illustrations of them are inserted, from which their artificial character is evident. The author's discussion of the questions involved is able and satifying.

D. G. BRINTON.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMICAL.

DR. SEE, of the University of Chicago, announced in the *Astronomical Journal* of November 13th that the well-known binary star 70 Ophiuchi exhibited anomalies in its motion which could only be explained on the supposition that there is a non-luminous perturbing body in the system. This matter acquires especial interest from the fact that this star is one of those binaries for which we possess a really accurate orbit. The theory of this star's motion published recently by Prof. Schur in the *Astronomische Nachrichten* is perhaps the most elaborate investigation of a double star orbit yet made. It was therefore very surprising to hear that the mean of thirteen nights' observations by three American observers gave the error of Schur's ephemeris as nearly five degrees in position angle, although only three years had elapsed since the computation of his orbit. The matter cannot yet be regarded as settled, for Prof. Schur shows in the last number of the *Astronomische Nachrichten* that the American observations are not in agreement with his own most recent heliometer observations, which agree very closely with his ephemeris. On the other hand, they are supported by the most recent observations at Paris by M. Callandreau, though these are in disaccord with those of Herr Ebell at Berlin. It is to be hoped that numerous observations of this most interesting star will be made in the near future. H. J.

PROF. E. C. PICKERING announces in Circular No. 4 from the Harvard College Observatory that a new star in the constellation Centaurus was found by Mrs. Fleming on December 12, 1895, from an examination of the Draper Memorial photographs. Its approximate position for 1900 is in R. A. $13^h\ 34^m$ .3, Dec. —31° 8′. Attention was called to it from the peculiarity of the spectrum on Plate B 14151, taken at Arequipa on July 18, 1895, with the Bache Telescope, exposure 52m. The spectrum resembles that of the nebula surrounding 30 Doradus, and also that of the star A. G. C. 20937, and is unlike that of an ordinary nebula or of the new stars in Auriga, Norma and Carina. This object is very near the nebula N. G. C. 5253, which follows $1^s.28$, and is north 23″. No trace of it can be found on 55 plates taken from May 21, 1889, to June 14, 1895, inclusive. On July 8, 1895, it appeared on a chart plate, B 13965, and its magnitude was 7.2. On Plate B 10472 taken July 10, 1895, its magnitude was also 7.2. On December 16, 1895, a faint photographic image of it, magnitude 10.9, was obtained with the 11-inch Draper Telescope, although it was very low, faint and near the sun. On this date, and on December 19, it was also seen by Mr. O. C. Wendell with the 15-inch Equatorial as a star of about the eleventh magnitude. An examination with a prism showed that the spectrum was monochromatic, and closely resembled that of the adjacent nebula. Although the spectrum is unlike those of the new stars in Auriga, Norma and Carina, yet this object is like them in other respects. All were very faint or invisible for several years preceding their first known appearance. They suddenly attained their full brightness and soon began to fade. Like the new stars in Cygnus, Auriga and Norma, this star appears to have changed into a gaseous nebula.

ANTARCTIC EXPLORATION.

The Century for January contains an article by Mr. Borchgrevink describing 'The First Landing on the Antarctic Continent,' which is the only account of his experiences which he has contributed for publication. He writes that he believes that Cape Adare is the very place where a future scientific expedition might stop safely even during the winter months. From this spot several accessible spurs lead up to the top of the cape, and from there a gentle slope runs on to the great plateau of Victoria Land. The presence of the penguin colony, their undisturbed old nests, the appearance of dead seals (which were preserved like Egyptian mummies, and must have lain there for years), the vegetation to the rocks, and lastly the flat table of the cape above, all indicate that here is a place where the powers of the Antarctic Circle do not display the whole severity of their forces. Neither ice nor volcanoes seemed to have raged on the peninsula at Cape Adare, and a future scientific expedition might well choose that place as a center of operations. On this particular spot there is ample space for house, tents and provisions.

Mr. Borchgrevink offers to be the leader of a party to be landed either on the pack or on the mainland near Colman Island. From there he would work toward the south magnetic pole, calculated to be in latitude 75° 5′, longitude 150° E. Should the party succeed in penetrating so far into the continent, the course should, if possible, be laid for Cape Adare, there to join the main body of the expedition. As to the zoölogical results of future researches, great discoveries may be expected. It would indeed be remarkable if on the unexplored Victoria continent, which probably extends over an area of 4,000,000 square miles, there should not be found animal life hitherto unknown in the southern hemisphere. It is of course a possibility that the unknown land around the axis of rotation might be found to consist of islands joined only by perpetual ice and snow; but the appearance of the land, the color of the water, with its soundings, in addition to the movements of the Antarctic ice, point to the existence of a mass of land much more extensive than a mere group of islands.

GENERAL.

Nature has in recent numbers urged the need of employing scientific experts and scientific methods in the public service. Twenty years ago a Royal Commission urgently advised the appointment of a Ministry and Council of Science. Its recommendations have never been carried into effect, and *Nature* deplores the lack of men scientifically trained and of proved ability and originality in the government departments. The United States government and the separate States undoubtedly do more for the advancement of education and science than does any other country, yet the administration compares unfavorably not only with France, where M. Berthelot, the great chemist, is Minister of Foreign Affairs, but also with Great Britain where the Cabinet includes men such as Lord Salisbury, Mr. Balfour and the Duke of Devonshire, who take sincere and intelligent interest in the advancement of science.

The Lecomte prize (50,000 fr.) of the Paris Academy of Sciences has been awarded to Prof. Ramsay and Lord Rayleigh for the discovery of Argon. The Valz prize has been awarded to Mr. W. F. Denning for astronomical work. The Albert Lévy prize (50,000 fr.) of the Paris Academy of Medicine has been awarded to Dr. Behring and Dr. Roux for the discovery of the serum treatment of diphtheria.

The *British Medical Journal* learns that the Calcutta municipality has decided that Dr. Haffkine's anti-cholera inoculation experiments are to be continued there for another year, and have assigned a grant of 7,500 rupees for this purpose.

Mr. Frank M. Chapman, of the American Museum of Natural History, will give the following lectures, 'On Birds, their Habits and Instincts,' under the auspices of Columbia College, in the Academy of Medicine, New York: January 7th, 'Distribution and Migration;' January 14, 'Sexual Relationships and Nesting Habits;' January 28, 'Color: its Nature and Uses;' February 4, 'Modification of Structure by Habit.'

The Chief of the Weather Bureau, Mr. Willis L. Moore, has answered an inquiry from the *Scientific American*, to the effect that the department is considering the feasibility of using weather forecasts as cancellation stamps in the post-office.

THE memoir of G. J. Romanes, edited by Mrs. Romanes, consists chiefly of letters, including an important correspondence with Darwin. It is expected that it will be published this month or in February.

WE learn from *Nature* that Prof. Bonney was presented with his portrait on December 16 by former geological students of the University of Cambridge and University College, London. Remarks were made by Mr. J. E. Marr, Miss Raisin and Prof. W. J. Sollas, and after the portrait had been unveiled Prof. Bonney replied.

THE annual election of officers of the Academy of Natural Sciences, Philadelphia, resulted in the election of Dr. Samuel G. Dixon to the presidency.

CABLEGRAMS state that a violent earthquake shock was felt on December 30, at Wiener, Neustadt, thirteen miles from Vienna.

THE *Weather-crop* Bulletin issued by the Department of Agriculture states that December, 1895, was generally slightly warmer than usual over the northern portions of the country, the average daily temperature excess being greatest in the Missouri Valley and northern New England, where it generally ranged from 3° to 6°. From the lower Ohio Valley northward to and including the southern portion of the upper Lake Region the average temperature for the month was about normal. The month was generally drier than usual in the Atlantic Coast and Gulf States, generally throughout the Rocky Mountain and Plateau districts and in California.

BEGINNING with the current number *The American Anthropologist* will be issued monthly instead of quarterly, and the subscription price will be reduced from $3 to $2 *per annum*. The number of pages in the volume will not be diminished. *The American Anthropologist* has during the eight years since it has been established printed a very large number of important papers on archæology, ethnology, folk-lore, sociology, philology and general anthropology, contributed by the leading American students of anthropology.

THE American Economic Association at its recent session in Indianapolis elected Henry C. Adams, of the University of Michigan, President, and Prof. Franklin H. Giddings, Columbia College, E. R. L. Gould, Johns Hopkins University and University of Chicago, and R. P. Falkner, University of Pennsylvania, Vice-Presidents.

THE *Medical News* has been removed from Philadelphia to New York, and Dr. Geo. M. Gould has retired from the editorship. The *Medical News* is one of the few weekly medical journals among the large number published in America that maintains a satisfactory scientific standard.

Nature announces that Prof. Sylvester has been elected an associate of the Brussels Academy of Sciences, Prof. Ray Lankester a corresponding member of the St. Petersburg Academy of Sciences, and Sir William Flower a foreign member of the Royal Swedish Academy of Sciences. The *Naturwissenschaftliche Rundschau* announces that Prof. R. Leuckhart has been elected an honorary member of the Paris Academy of Sciences.

THE *National Geographic Magazine* will hereafter be published on the first of each month under the editorship of Gen. A. W. Greely, Dr. W J McGee, Miss E. R. Scidmore and Mr. John Hyde. Subscriptions may be sent to the Secretary of the National Geographic Society, 1515 H street, Washington, D. C.

A REPORT issued from the Hydrographic Office describes the floating ice seen during 1892 and 1893 in the South Atlantic east of Cape Horn. It is said that the icebergs were of such size that they could not have been formed on small, low-lying islands, but only on a large continent of such height that great glaciers could be formed.

A CIRCULAR has been issued by several members of the Connecticut Academy of Arts and Sciences urging that more support be given to the Academy.

DR. JOHN RUSSELL HIND, the eminent British astronomer, died at London on December 23, in his seventy-third year. He was the author of important researches, especially on comets, and published works on this subject and on general astronomy. He was for many years superintendent of the *Nautical Almanac*. He had held the offices of Foreign Secretary and President of the Royal Astronomical Society, and was a member of the most important scientific societies.

ALFRED E. BEACH died in New York on January 1st. He was one of the proprietors of the *Scientific American* and had made several important inventions, the best known of which is that of pneumatic tubes adjusted for carrying parcels and cars. The deaths are also announced of Robert F. Welsch, a writer of ichthyology; of Prof. A. P. Kostycher, of the Russian Agricultural Department, known for his investigations of soils and agricultural products; of Dr. A. V. Brunn, professor of anatomy in Rostock, and of Dr. Ludwig Teichmann, formerly professor of anatomy in Cracow.

UNIVERSITY AND EDUCATIONAL NEWS.

A BILL to establish a National University at Washington has been introduced in the Senate and House of Representatives. It provides for its government a board of sixteen regents, with the President of the United States at its head, and a University Council, embracing the board and twelve educators, representing institutions belonging to different States.

A TELEGRAM to the *Evening Post* states that Elon College, in North Carolina, has received an endowment fund of $100,000 from a citizen of New York City, whose name is not at present made public.

PRESIDENT Mark W. Harrington, of the University of Washington, writes that he proposes to establish a department of terrestrial physics and geography in the University, and will be indebted to authors and publishers who will send to the University publications relating to these subjects.

THE N. Y. *Medical Record* states that the Chicago College of Physicians and Surgeons is making arrangements to amalgamate itself with the University of Illinois

IT is stated that Mrs. E. G. Kelly, of Chicago, will erect a chapel at a cost of $100,000 for the University of Chicago, as a memorial to her brother.

DR. DOCK, of the University of Michigan, has been appointed professor of pathology and bacteriology at Jefferson Medical College in Philadelphia.

WE learn from the *American Geologist* that Prof. W. I. Blake, of New Haven, Conn., has accepted a professorship of geology and mining in the University of Arizona.

DR. HÜFNER, of Tübingen, has been called to the chair of physiological chemistry at Strassburg, vacant by the death of Hoppe-Seyler. Dr. Julius Bauschinger, of Munich, has been made associate professor of astronomy and head of the bureau of calculations in Berlin.

ACCORDING to the *Academische Revue* the number of students matriculated at the University of Berlin is 5368: 486 in theology, 1812 in law, 1258 in medicine and 1812 in the philosophical faculty. There are 776 foreigners, 219 from America, 198 from Russia, 32 from Great Britain, 22 from France, etc. 40 women are admitted as auditors.

CORRESPONDENCE.

THE THEORY OF PROBABILITIES.

TO THE EDITOR OF SCIENCE: It is easier to make true and misleading statements in the subject of probabilities than anywhere else. In this class I should be inclined to place the remark made by Professor Mendenhall, near the close of his article in your issue for December 20, regarding a deal in whist in which each of four players had all the cards of one suit. He says:

"The chances against any other particular distribution of the cards were just as great as against this and * * * the result of every deal of the cards is just as remarkable as this."

To the first part of this statement it is of course impossible to take exception; the second part seems to me misleading, if not untrue. To take another case. The chances of my tossing heads one hundred times running are precisely those of my tossing the particular succession of heads and tails that I do toss in any hundred throws of a coin. But is the former case no more *remarkable* than the latter? It is so much more remarkable that it at once arouses the suspicion that I have committed fraud, while in the other case no one thinks of such a thing, unless—and here lies the gist of the whole matter—unless I or somebody else predicted exactly the succession of heads and tails that occurred. The remarkableness lies in the coincidence, not in the mere numerical probability of the configuration. Now the distribution of cards mentioned by Prof. Mendenhall and the succession of throws of a coin in which all are heads are both natural arrangements that readily occur to the mind, and hence are as striking subjects for coincidence as actually predicted arrangements. The fact is that an unpredicted arrangement is not judged 'remarkable,' because its probability is compared with that of *each and every* (individual) other possible arrangement, while with a predicted or other coinciding arrangement the comparison is between its probability and that of *any* other possible arrangement (no matter what). We may call the ratio of such comparison the 'ratio of surprise,' if you will. When heads turn up twice in succession the numerical probability ($\frac{1}{4}$) is precisely that of every other possible succession of heads and tails, but its ratio of surprise is $\frac{1}{4} \div \frac{3}{4} = \frac{1}{3}$, whereas that of an arrangement not subject to comparison with some predicted or conspicuous arrangement is $\frac{1}{4} \div \frac{1}{4} = 1$. The distribution of cards already mentioned belongs to the former class of configurations, and its 'ratio of surprise' is almost infinitesimal. It is therefore very remarkable, while an ordinary deal would not be so.

Professor Mendenhall of course does not need to be told of any of these things, but it seems worth while to call attention to what will seem, to the non-mathematical reader, a lack of correspondence between scientific and ordinary language—a thing to be avoided when possible.

ARTHUR E. BOSTWICK.

MONTCLAIR, N. J.

THE DEVELOPMENT OF THE EMBRYO OF PTERIS.

TO THE EDITOR OF SCIENCE—*Sir:* For two years I have been in correspondence with various biologists concerning a very evident error in Sedgwick and Wilson's Biology, and had I supposed it possible that the new edition would repeat such an error, I would have at least tried to prevent it. I refer to the oösphere quadrant developments as mentioned in the texts, old edition, bottom page 98 and top of page 99; New edition, top of page 140. He says in both places: 'The lower anterior quadrant as it undergoes further division grows out into the first root; the upper anterior quadrant in like manner gives rise to the rhizome and the first leaf.'

In a note below Fig. 80, in both editions he gives the truth in the matter but says: 'In *Pteris serrulata* the development is slightly (!) different.'

Where and how does the author obtain his authority for the statement as it stands in the text, making the root spring from the anterior quadrant?

Please call attention of botanists to this statement, and if any of them have obtained such a result with *Pteris aquilina*, let us hear from them and see their drawings.

F. D. KELSEY.

OBERLIN, OHIO, December 12, 1895.

TO THE EDITOR OF SCIENCE—*Sir:* Prof. Kelsey has our thanks for pointing out an obvious error in our description of the development of the embryo of *Pteris* from the oöspore. We can only regret that while corresponding 'for two years,' concerning the matter, 'with various biologists,' he did not include us among the number, as he might then, possibly, have saved himself some trouble and would have enabled us more promptly to correct the error.

THE AUTHORS OF THE *General Biology*.

LINE DRAWINGS OF BLUE PRINT.

THE method of making line drawings upon a blue print, mentioned by Mr. Slosson on page 893 of the last volume, is capable of being made very useful. I have used it for a number of years, and some of the results have appeared in the horticultural bulletins of the Cornell Experiment Station. I have no artistic ability, and yet one of these blue-print drawings was highly commended by an artist, who, fortunately, knew neither who the draughtsman was nor what was the method of its making!

L. H. BAILEY.

CORNELL UNIVERSITY.

SCIENTIFIC LITERATURE.

Charles Lyell and Modern Geology. By PROF. T. G. BONNEY, F.R.S. *The Century Science Series.* Macmillan & Co., New York. 1895. Pp. 221, with index. $1.25.

The life of Charles Lyell, its fruition in the twelve editions of the Principles of Geology, and Lyell's influence on modern geology, form a subject worthy of the admirable treatment given it by Prof. Bonney. Brief as it is, this biography adequately spans his seventy-eight years, showing how he trained himself broadly in liberal knowledge and in science; how he developed a single purpose—'to put geology on a more sound and philosophical basis'—and how he pursued it so earnestly that Darwin could say: 'The science of geology is enormously indebted to Lyell—more so, as I believe, than to any other man who ever lived.'

Charles Lyell, born in 1797, the oldest son of Charles Lyell, sprang from a cultured family. His father was a student of literature and a lover of natural history, with a particular interest in entomology and botany. Thus the son inherited tastes which, developed by early associations as well as by Oxford training, fitted him for his life task as author and scientist. In spite of near sightedness, he was an accurate observer; he thought clearly; and his thought was no less clearly stated. The power of analysis and the power of expression, highly developed in combination, ever place their possessor among the leaders of men.

Lyell's studies in geology began in 1817 with lectures by Prof. Buckland, who was only thirteen years his senior and had been but recently appointed reader in geology at Oxford. Buckland roused enthusiasm for the science, but did not establish in his student's mind the verity of the diluvial theory. Ten years of study, rest for his eyes's sake, and travel on the Continent as well as in England, led Lyell from the profession of law, which he had entered upon, to the pursuit of geology. In 1828 he spent four months with Murchison in the volcanic district of central France, which Scrope had just made known to scientists. "The great flows of basalt—some fresh and intact, some only giant fragments of yet vaster masses—the broken cones of scoria, and the rounded hills of trachyte in Auvergne, supplied him with links between existing volcanoes and the huge masses of trap with which Scotland had made him familiar; while these basalt flows—modern in a geological sense, but carved and furrowed by the streams which still were flowing in their gorges—showed that rain and rivers were most potent, if not exclusive, agents in the excavation of valleys."

"The whole tour," wrote Lyell to his father, "has been rich, as I had anticipated (and in a manner which Murchison had not), in those analogies between existing nature and the effects of causes in remote eras which it will be the great object of my work to point out. I scarcely despair now, so much do these evidences of modern action increase upon us as we go south (towards the more recent volcanic seat of action), of *proving* the positive identity of the causes now operating with those of former times."

In 1829 the discussions were hot in the Geological Society between those who maintained the hypothesis of a universal deluge, and those who interpreted Nature through uniformity of modern and ancient causes. In April Lyell wrote to Dr. Mantell:

"A splendid meeting (at the Geological Society) last night, Sedgwick in the chair. Conybeare's paper on Valley of the Thames, directed against Messrs. Lyell and Murchison's former paper, was read in part. Buckland present to defend the 'Diluvialists.' * * * Greenough assisted us by making an ultra speech on the importance of modern causes. * * * Murchison and I fought stoutly, and Buckland was very piano. Conybeare's memoir is not strong by any means. He admits three deluges before the Noachian; and Buckland adds God knows how many *catastrophes* besides; so we have driven them out of the Mosaic record fairly."

How faintly, like blows of battle-axe on medieval armor, rings the echo of that controversy in this day! Yet it was the first and not the least of Lyell's services that he led the attack which drove that hypothesis of the theologians from its intrenched position.

Tried in debate and developed thereby, Lyell's ideas begot a purpose which absorbed his means, his time and his thought. That purpose is stated in the title of his book: 'Principles of Geology; being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation.' To this end he devoted the energies of a life singularly free from limitations and cares, such as ordinarily divert men from a single object.

The first volume of the Principles was written in the autumn of 1829, and published in the winter; the second appeared early in 1832, and the third in May, 1833. Five editions of the work had been issued by the spring of 1837. In 1838 the third volume was published separately as the 'Elements of Geology,' and the Principles, thus curtailed, passed through editions from the sixth to the eleventh during the author's lifetime, the twelfth being under way at the time of his death, in 1875.

Thus for forty-five years he pursued his purpose. There is danger in lifelong devotion to one hypothesis, but Lyell was armed against narrowing bias by his methods of observation and by the breadth of his mind. The hypothesis, which a small man would have spun to a vanishing thread, in Lyell's hands was forged into a chain of causality, binding past and present.

In accordance with one favorite saying of his: 'Go and see,' he travelled throughout western Europe and eastern America, searching always with painstaking care for facts. And obeying another principle, 'Prefer reason to authority,' (even when that authority was his own published conclusion), he kept his work abreast of the advance of geology, for which he had indicated the way.

Uniformitarianism did not originate with Lyell, but he became the great exponent of that principle. Not priority, but thoroughness, makes for reputation. Weighing the broader results of Lyell's studies, Prof. Bonney concludes: "We may be sure, that if Lyell were now living he would frankly recognize new facts, as soon as they were established, and would not shrink from any modification of his theory which these might demand. Great as were his services to geology, this, perhaps, is even greater—for the lesson applies to all sciences and to all seekers after knowledge—that his career, from first to last, was the manifestation of a judicial mind, of a noble spirit, raised far above all party passions and petty considerations, of an intellect great in itself, but greater still in its grand humility; that he was a man to whom truth was as the 'pearl of price,' worthy of the devotion and, if need be, the sacrifice of a life."

BAILEY WILLIS.

Die Gastropoden der Plankton-Expedition, von DR. H. SIMROTH. Kiel & Leipzig, Lipsius & Fischer. 1895. 4to., 206 pp., 22 pl.

The Plankton-Expedition, as many of our readers are aware, had for its object the study of pelagic life in the North Atlantic, and especially its distribution in depth; the drawing, as it were, of the bathymetric contours of oceanic life. The material thus gathered has been distributed among many naturalists for study, and a large number of essays have already been printed under the supervision of the general editor, Prof. Victor Hansen, of Kiel.

The latest contribution is by Prof. Heinrich Simroth, of Leipzig, already well known by numerous valuable studies of the mollusks, and especially by his editorship of the new edition of that part of Bronn's 'Thier-reichs' relating to the Mollusca. It comprises observations on larval and pelagic Gastropods, fully illustrated and of great interest.

After the reaction against the methods of descriptive biology based on superficial characters, which began about twenty-five or thirty years ago, so rich were the results derived from embryological and anatomical researches that the more hasty of the younger workers concluded in their enthusiasm that surface characters were of no value whatever; and this view was carried so far that we find one naturalist gravely arguing that the only proper basis for a classification of the Gastropods would be found in the number and arrangement of the ganglionic cells, which he had studied in half a dozen species of land snails. Even the better informed and more cautious biologists were led to doubt if the characters of the shell in mollusks would lend any aid to the study of the evolution of the group. Fortunately, these views have proved illfounded, and a more minute and exhaustive study of shell characters in some groups has shown that valuable assistance in working out lines of development and the relations of different forms may be obtained by those who properly study the shell, its larval forms and dynamic relations to the organism. No one now doubts the importance of such studies in such large groups as the Ammonoid and Nautiloid cephalopods, the Volutidæ among gastropods, and the Naiades among pelecypods.

The study of the stages of evolution of the larval characteristics is a field hardly entered upon and promising rich returns to the student, and, for the paleontologist, deprived of all anatomical aid in tracing the lineage of peculiar extinct genera, the necessity of study of the nepionic stages of the fossils is fundamental.

For these reasons all contributions to our knowledge of existing larval forms are welcome, especially with such a wealth of illustration as in the present volume. Among the more important matters in it we find a very full account of *Janthina*, in both adult and larval states; of larvæ of the type of *Echinospira*, belonging to the Lamellariidæ; of the *Macgillivrayia* type like those of *Tritonium* and *Dolium;* of the *Sinusigera* type, including many genera of Rhachiglossa and Toxoglossa; a general discussion of the conditions of larval existence and their bearing on the characters developed; some account of pelagic nudibranchs, such as *Glaucus* and *Fiona;* a table showing the quantitative results of the dredging or towing nets; and a bibliography of literature consulted.

The only criticism which suggests itself is that it would be more convenient for those who have to use the book if the magnification of the figures was stated in units of the whole length, rather than merely indicated by the name and number of the objective used for the microscopic work. W. H. DALL.

The Structure and Development of Mosses and Ferns. By DOUGLAS HOUGHTON CAMPBELL, Ph.D., Professor of Botany in the Leland Stanford, Jr., University. 8vo. Pp. 544. London, Macmillan & Co. 1895.

The results of the long continued and patient work that Dr. Campbell has been publishing from time to time on the Pteridophytes have at last been brought together, with the results of a large amount of new work on the Hepaticæ and other Bryophytes, and the whole results in a large volume issued by the well-known publishers, Macmillan & Co., under the above attractive title.

The first thing to be noted as praiseworthy in the book is clearness and simplicity of expression, for while dealing with a recondite subject and using strictly technical terms, the book reads smoothly and is devoid of that stilted language that too frequently characterizes works of this nature. The logical arrangement of the matter follows closely on the simplicity of style and these two features are sufficient to recommend the work to the learner, for too many are repelled from many a fascinating subject by the nature of the language and the lack of a systematic arrangement of the matter.

But beyond these questions of form the subject-matter is fresh and direct from the hand of the laboratory worker. The studies on which the work is primarily based were made from American plants, many of them plants from the Pacific coast that have never before been studied from the developmental and morphological standpoint. Riccia hirta, Fimbriaria Californica, Porella Bolanderi, Anthoceros fusiformis, Ophioglossum pendulum (from Hawaii), Botrychium Virginianum and Marsilea vestita are only a few of the new plants that have been called in to contribute their life history for the verification and often modification of the work of Hoffmeister, Kny, Gœbel, Strasburger and others made on similar plants of central Europe. As one result of this new study, Dr. Campbell has given us a fresh supply of illustrations in place of the standard stock that has become threadbare from long usage in European and American text-books. If some of the illustrations are not quite so clear cut as some that have appeared in certain European publications of recent date, they more than make up for this in their freshness and accuracy for they represent exactly the conditions met with by the author and have not been filled in by the imagination, as is sometimes the case.

We are pleased to note that for the first time in any somewhat general treatise of botany the Hepaticæ have received something like their proper treatment, and their representative position as a highly important group from the standpoint of phylogeny is clearly stated at the outset and strikingly developed through the work. A fair estimate of their differentiation and highly probable antiquity is also well set forth.

Dr. Campbell regards the lowest Metzgeriaceæ, like Sphærocarpus, as the simplest plants of the entire group and considers that the other groups of the Hepaticæ were differentiated from the ancestors of some plant of this character before the development of the sporophyte had advanced so far as in present forms of that genus. He sets forth a most excellent answer to the remarkable position of Goebel regarding the status of Buxbaumia and contributes several new points bearing on the interrelationships of the various groups of the true mosses.

In classification Dr. Campbell does not depart widely from arrangements that have heretofore been set forth, in the Hepaticæ, for instance, following the lead of Schiffner. The position of Isoetes as the possible ancestor of the Angiosperms is perhaps the most divergent point presented in the classification.

Comparison of the work of others is well made, and wherever criticism occurs it is always in the friendly, urbane spirit that ought always to characterize workers in science; where conclusions are stated, they are couched in pointed and forcible language but never dogmatically. Altogether the work is a valuable contribution and will stand comparison with the best work of the kind that has been done anywhere.

L. M. UNDERWOOD.

Molecules and the Molecular Theory of Matter, by A. D. RISTEEN, S. B. Ginn & Co. Octavo, pp. 213.

This is an excellent resumé of the present state of our knowledge of the molecular theory, excluding most of the more difficult mathematical discussions, and including the principal conclusions of Clausius, Kelvin, Boltzmann, Maxwell and many others who have cultivated this department of physical science.

After some general considerations involving a presentation of the hypothesis of molecules and a definition of what is meant by a molecule, together with a brief statement of the assumed molecular constitution of solids, liquids and gases, the kinetic theory of gases is seriously taken up. The fundamental assumptions of the theory are discussed, Maxwell's Theorem is proved and the statistical method of treatment illustrated. The results of the kinetic theory are compared with the results of observation, and the chapter includes an examination of high vacua phenomena, the radiometer and other of Crookes' experiments.

The chapter on the Molecular Theory of Liquids includes, among other things, a fairly complete elementary study of surface tension and the phenomena of films. Chapter IV. is given to the Molecular Theory of Solids, concerning which there is really little known, but interesting studies of the phenomena of solution, diffusion, crystallization, etc., are here given. The concluding chapters on the Molecular Magnitude and the Constitution of Molecules are important and well done. The principal methods for determining molecular dimensions are gone into pretty thoroughly and the more recent hypothesis in regard to the constitution of the ether and the nature of matter are presented with great clearness and some fullness.

Among a few unimportant criticisms of the book that suggest themselves may be mentioned the holding on to the 'lecture' form of presentation. The foundation of the work was a lecture given by the author before the Washburn Engineering Society of the Worcester Polytechnic Institute, but it has been so expanded, and so much additional material has been supplied that it exceeds the limits of several lectures. As a large part of the new material is not in the lecture form and as little is gained by retaining it anyhow, it is to be regretted that the author did not reject it in the beginning.

As an echo of the discussion which occurred at the recent meeting at Springfield of the Society for the Promotion of Engineering Education, it may be well to note that on one or two pages this book illustrates the fatal results which are almost sure to follow the use of the formula $W=mg$, in the good old orthodox way. The author is lucky, however, in having apparently followed Dr. Oliver Lodge who said that "The real rule on Engineers' principles would be to put 'g' somewhere into the expression for any quantity with which gravity has nothing to do, and to leave 'g' out whenever gravity is primarily concerned." By conscientiously adhering to this rule one may come out fairly well in the end, but in the present instance the confusion is more likely to be due to an oversight. On the whole the book will be a welcome addition to the library of any physicist who desires to avoid the necessity for much laborious research among original sources.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, DECEMBER.

THE principal article in this number of the Journal is one by C. F. Mabery on the composition of the Ohio and Canadian sulphur petroleums. In this article, which is only a partial report of the work, he reviews and discusses the work of other chemists in this field, and describes methods and forms of apparatus used in his investigations. As decomposition takes place in the distillation of crude petroleum during refining process, he could not use these products, but started with the crude oil and subjected it to fractional distillation *in vacuo*, in apparatus specially devised for this purpose. He found in the distillation of Ohio petroleum that no color or odor could be detected in the distillates below 235°; but above this point decomposition took place with evolution of hydrogen sulphide. The amount of ash left was small, and consisted chiefly of lime and magnesia, showing that the oil had dissolved some of the constituents of the rocks forming the cavities in which it was confined. A number of the lower-boiling hydrocarbons belonging to the methane series were isolated, and it was found that they were present in smaller quantities in the Ohio petroleum than in that from Pennsylvania.

Stillman and Yoder find that the compound formed by the action of anhydrous ammonia on aluminium chloride is $AlCl_3.6NH_3$. In their experiments dry air and ammonia were passed over aluminium chloride, and a partial decomposition of the product formed was always observed. The ammonia was partly oxidized, and water, aluminium oxide, and ammonium chloride formed.

Schlundt and Warder in an article, entitled, 'The Chemical Kinetics of Oxidation,' contribute some results on the speed of reactions under different circumstances. They find that the rate of liberation of iodine in a mixture of potassium chlorate, potassium iodide and hydrochloric acid is influenced by temperature, concentration and amount of excess of inorganic acid present.

L. W. McCay publishes a preliminary notice on the existence of the sulphoxyantimoniates. He finds that the salt prepared by Rammelsberg, and supposed by him to be a double salt, is potassium orthodisulphoxyantimoniate.

Freer gives the results of some experiments with tetrinic acid which are not in accord with the views of Nef and others on this subject. He finds that by the action of bromine on methylacetoacetic ester or its sodium salt, a uniform product is not obtained, but a mixture of four compounds. Two of these products are α- and γ-brommethylacetoacetic ester. From the latter tetrinic acid is easily formed; but, from the former, only in the presence of hydrobromic acid. There is a review in this number of 'The Principles and Practice of Agricultural Analysis' by H. W. Wiley, and obituary notices of Louis Pasteur and Felix Hoppe-Seyler.

J. ELLIOTT GILPIN.

NEW BOOKS.

Die Hausthiere. EDWARD HAHN. Leipzig, Duncker & Humblot. 1896. Pp. x+581.

Lecture Notes on Theoretical Chemistry. FERDINAND G. WEICHMANN. 2d edition. New York, John Wiley & Sons; London, Chapman & Hall, Lt'd. 1895. Pp. viii+288.

Manual of Lithology. EDWARD H. WILLIAMS. 2d edition. New York, John Wiley & Sons; London, Chapman & Hall, L't'd. 1895. Pp. 418.

Report of the Columbian Historical Exposition. Madrid, 1892; Washington, 1895. Pp. 411.

Lessons in Elementary Botany. THOMAS H. MACBRIDE. Allyn & Bacon, 1896. Pp. xi + 233. Introductory price, 60 cts.

SCIENCE

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FRIDAY, JANUARY 17, 1896.

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THE ASSOCIATION OF AMERICAN ANATOMISTS.

REPORT OF THE EIGHTH ANNUAL MEETING.

THE Eighth Annual Meeting of the Association of American Anatomists was held in the College Hall of the University of Pennsylvania, Philadelphia, Pa., December 27 and 28, 1895. The President, Dr. Thomas Dwight, presided. The following members were present during the meeting: Doctors Harrison Allen, Frank Baker, A. D. Bevan, H. L. Birkett, F. J. Brockway, W. A. Brooks, C. E. Cotton, Thos. Dwight, P. A. Fish, W. S. Forbes, F. H. Gerrish, M. J. Greenman, C. A. Hamann, Addinell Hewson, E. R. Hodge, E. W. Holmes, G. S. Huntington, D. S. Lamb, John Lindsay, J. Ewing Mears, C. S. Minot, R. O. Moody, J. P. Tunis and B. G. Wilder.

Prof. E. D. Cope, Horace Jayne, Theodore Gill, F. A. Lucas, Washington Matthews, H. F. Osborn and W. B. Scott, of the Association, were mainly occupied with the meetings of the affiliated societies.

The following new members were elected: W. G. Christian, M. D., Professor of Anatomy, University of Virginia. Clyde E. Cotton, M. D., Assistant Demonstrator of Anatomy, University of Pennsylvania. Gilman D. Frost, M. D., Professor Anatomy Medical Department, Dartmouth College. Robert H. M. Dawbarn, M. D., Professor Surgical Anatomy and Operative Surgery, New York Polyclinic. Wm. E. Lewis, M.

D., Professor Descriptive and Surgical Anatomy, Cincinnati College of Medicine and Surgery. John Lindsay, M. D., Assistant Demonstrator of Anatomy, University of Pennsylvania. Alfred L. T. Schaper, Demonstrator of Histology and Embryology, Harvard Medical School. Geo. D. Stewart, M. D., Lecturer on Anatomy, Bellevue Hospital Medical College. B. B. Stroud, D. Sc., Instructor in Physiology, Vertebrate Zoölogy and Neurology, Cornell University. Joseph P. Tunis, A. B., M. D., Assistant Demonstrator of Anatomy, University Pennsylvania. George Woolsey, M. D., Professor Anatomy, University of City of New York.

The following were elected to Honorary Membership: Prof. Wm. Henry Flower, London, England; Sir Geo. Murray Humphry, Cambridge, England.

The following members resigned: Tracy E. Clark, B. S., Professor of Natural History, Clinton Liberal Institute, Ft. Plain, N. Y., and Maurice Howe Richardson, M. D., Assistant Professor Anatomy, Harvard Medical School.

Dr. Frank Baker, of Washington, was elected President for the next term; Dr. Addinell Hewson, of Philadelphia, Delegate to the Executive Committee of the Congress of American Physicians and Surgeons; and Dr. A. D. Bevan, of Chicago, a member of the Executive Committee. Dr. Geo. S. Huntington, of New York City, was added to the Committee on the Table at Naples.

The Committee on Anatomical Nomenclature made the following report:

The Committee report general progress in the consideration of the complex subject entrusted to them and express the opinion that substantial improvement will result from the work of the Committee of the *Anatomischer Gesellschaft*.

Your committee recommend to anatomists that, other things being equal, terms consisting of a single word each be employed rather than terms of two or more words. Harrison Allen, Chairman; Thomas Dwight, Frank Baker, Frederick H. Gerrish, Burt G. Wilder, Secretary.

The committee on the collection and preservation of anatomical material, consisting of J. Ewing Mears, J. D. Bryant and Thomas Dwight, made the report which is appended (see page 77).

The Secretary was instructed to have a copy of the amended report and a copy of the Presidential address sent to the Professors and Demonstrators of Anatomy in the United States and Canada.

The Secretary reported that there were 115 active members and five honorary.

The following papers were read:

1. 'Myology of the extremities of Lemur Bruneus.' Illustrated by drawings and casts of muscles. Dr. George S. Huntington, New York City.

2. 'History of the Ciliary Muscle.' Dr. Frank Baker, Washington, D. C.

3. 'Absence of Fibrous Pericardium of left side.' Illustrated by specimen. Dr. Addinell Hewson, Philadelphia, Pa.

4. 'The Descriptive Anatomy of the Human Heart.' Dr. Wm. Keiller, Galveston, Texas.

5. 'Nomenclature of Nerve Cells.' Dr. Frank Baker, Washington, D. C.

6. 'The Cerebral Fissures of Two Philosophers.' Illustrated by specimens and photographs. Dr. B. G. Wilder, Ithaca, N. Y.

7. 'The Human Paroccipital Fissure; Should it be Recognized and so Designated?' Illustrated by specimens and photographs. Dr. Wilder.

8. 'Practical Histology for Large Classes.' Dr. Chas. S. Minot, Boston, Mass.

9. 'Some Novel Methods of Description of the Human Skull.' Dr. Harrison Allen, Philadelphia, Pa.

10. '*Fossa Capitis Femoris*, with Observations on the Trechanteric Fossa.' Illus-

trated by specimens. Dr. F. J. Brockway, New York City.

11. 'Note on the Appearance of a Unilateral Tuberosity in Place of the Trochanteric Fossa.' Illustrated by specimen. Dr. D. S. Lamb, Washington, D. C.

12. 'A Case of Polyorchis.' Illustrated by specimen. Dr. D. S. Lamb.

13. 'The Cerebrum of Phoca Vitulina.' Illustrated by specimen. Dr. P. A. Fish, Washington, D. C.

The members of the Association were entertained by Dr. Horace Jayne, of Philadelphia, who gave a reception on the night of the 26th; were lunched on the 27th and 28th by the University authorities, and on the 28th by Mr. W. B. Saunders at the Art Club.

The courtesies of the American Philosophical Society were also extended. On the evening of the 26th they also listened to a lecture by Prof. W. B. Scott, of Princeton, N. J., on the 'History of the Lacustrine Formations of North America and their Mammalian Fossils.'

A banquet by members of the affiliated societies was given on the evening of the 27th at the Hotel Lafayette and was well attended.

D. S. LAMB,
Secretary.

OUR CONTRIBUTION TO CIVILIZATION AND TO SCIENCE—PRESIDENTIAL ADDRESS BY DR. THOMAS DWIGHT, HARVARD MEDICAL SCHOOL.

It had not been my intention to inflict upon the Association a Presidential address; but at a late moment, impressed with the gravity of the matters that are to come before us, far transcending as one of them does, the importance of purely scientific discussion, I felt it a duty I owe to the position I have the honor to hold, to introduce them to the Association with the best suggestions concerning them I can offer. It is not too much to call them our contribution to civilization and to science. Easily first in importance is the report of the committee on procuring and using anatomical material. Though both branches of the question are of interest to anatomists, the first rises beyond the sphere of the specialist. It is a social question of the first importance. I shall not anticipate the report of the committee, of which I am a member. I wish merely to lay down briefly certain principles which, I conceive, should guide us. We know only too well that dissection is an abomination to the popular mind. The aversion to it is well nigh universal, confined to no class of society, nor to any creed. This horror seems to be founded chiefly on two points, one the deprivation of sepulchre, the other the idea that the remains are submitted to wanton insult. The idea that respect is due to the dead body is so deeply rooted in the human mind as to be almost instinctive. I am far from calling these feelings superstitious. We know, indeed, that no violence can harm the dead, but, though reason is convinced, the heart is not satisfied. We anatomists, no less than others, shudder at the thought of the desecration of the remains of those who have been near and dear to us. The mad wrath caused by the feeling that graves are not safe is a well justified one. It is a disgrace to our civilization that in some parts of the Union body-snatching is still practised, and that in others there exists an illicit trade in human bodies. Should any of my colleagues think me indiscreet in alluding to these matters, I must remind them that I am saying nothing which has not been made notorious through the public press.

It is idle to hope, while human nature remains what it is, that aversion to dissection will ever disappear. Our wisest course is to recognize it, and to soften it by removing all just cause of complaint. It should be made clear to the public that dissection can and should be followod by decent burial. I, myself, would go so far as to have the bodies of Protestants and Catholics buried in their respective cemeteries, when the creed of the deceased is known. It also should be understood that no wanton insult is permitted in reputable schools.

From careful observation I am convinced that the policy which will lead to the most satisfactory results is one of complete openness, that above all, we should avoid a timidity which shirks discussion of this topic. When we shall show so clearly as to carry conviction, that we have nothing to conceal, a great step will have been taken. I like to boast that the anatomical department of the Harvard Medical School is ready to give an account of every body it receives. If there be aught in the management of dissecting rooms that calls for criticism, I would not have reform forced upon us from without. Let us be the first to anticipate every reasonable demand.

It seems to me that this is making every possible concession to the sentimental side of the question; but another complaint is often made in all honesty, by well-meaning persons, who object that the bodies of the poor should be treated otherwise than those of the rich. I reply that no one would reprobate more strongly than I any law that would allow the taking of the bodies of the poor from their near relatives; but we must distinguish between the respect due to the feelings of the living and any admission that dissection is in itself an injury to the dead. The former is humanity; the latter is superstition, and to my mind a very contemptible one.

I have alluded to the scandal of body-snatching, but an equally great scandal is its cause; the want, in many places, of an anatomy act, or the existence of one which the framers and all others know to be inadequate. This state of affairs is in more respects than one an injury to the community. Like a prohibitory law meant to be boasted of on the platform and in the pulpit, but not meant to be inforced, it destroys respect for law. It is the bounden duty of authorities of States, without adequate provision for dissection, to see that it is not practiced. After all, such communities deserve to be treated by surgeons ignorant of anatomy.

A radical defect in the laws of many States, otherwise well drawn, is that the delivery to medical schools of unclaimed bodies is optional with superintendents, Boards of Trustees and municipal authorities. The result of this is that those in authority very naturally hesitate to do anything for the advancement of science, which not only can be of no possible advantage to themselves, but may involve them in serious difficulties. The cry of outrage on the poor is a sure card in the hand of the political demagogue, especially when it is raised against some honored institution. It may also be used as a means of annoyance against political opponents. It is far easier, therefore, for those in office to remain quiet and leave science to suffer. A mandatory law would free them from all responsibility. 'Thyself shalt see the act,' would be a sufficient answer to all complaints.

Details of law may and must differ with the locality, but a good anatomy act should have the following characteristics: First, it should be just, safeguarding the rights of the poor, and securing decency; next, that it should be mandatory; finally, it should be easy of execution. It is our duty in our several States to do our utmost for the passage of a law that shall advance science, protect the grave and do credit to the community. We have not the excuse of older times that the question is a new one. In view of our own shortcomings it behooves us to judge them lightly. For my part, I have far more respect for those who opposed dissection on the ground, however mistaken, that it might be displeasing to God, than for those who make it illegal by pandering to the prejudices of the ignorant. Dr. Johnson's advice, 'free your mind from cant,' is here singularly *à propos*. We cannot boast of our civilization till this is remedied.

Another subject which comes before us for discussion is the important question of anatomical nomenclature. German anatomists have recently adopted a report prepared by some of their number, working in company with representatives of other European countries. It is for us to consider whether this one can be looked upon as accepted and whether it is acceptable; whether we can join hands with our foreign colleagues, or whether we can devise an American nomenclature which shall be so much better that we can disregard the inconvenience of a distinct standard. We have had for years a committee on anatomical nomenclature, with Professor Wilder for secretary, who has given so large a part of his busy life to this matter. We may expect an important contribution to the matter in the report of this committee.

We are to hear also from the committee appointed to consider the anatomical peculiarities of the negro. I am not informed what success has been reached in the difficult task of collecting statistics. It is a work of such anthropological importance that it would be doubly to be regretted should it come to naught. As has already been said at our meetings, it is most proper that this Society should collect all possible information as to the anatomy not only of the negro, but of such savage races as still survive in North America, and of the extinct ones, whose bones can still be procured in large numbers.

Thus, gentlemen, you see that this meeting, besides the attractive list of papers, has before it matters of no ordinary interest and importance. I will no longer detain you from your work, firmly persuaded that the action of this Association will be in the interest of civilization and science.

REPORT OF THE COMMITTEE ON THE COLLECTION AND PRESERVATION OF ANATOMICAL MATERIAL.

To the Association of American Anatomists:

The committee appointed at the meeting of the Association to obtain information with regard to the collection and preservation of anatomical material, and report what in their opinion are the best means of accomplishing these objects, begs respectfully to submit the following report:

In order to make the work of the committee as comprehensive as possible and to obtain information which would be of service in arriving at definite conclusions as to the best methods of accomplishing the purposes in the resolution, the committee deemed it desirable to send to the teachers of anatomy, not only in this country, but abroad, a circular letter, with the following questions appended, and respectfully requested answers to be made thereto as fully as possible:

1. Is anatomical material obtained in accordance with legal enactment, wholly or in part?

2. Is there an Anatomical Law in your State or country? If so, please send a copy to the chairman of the committee. Please state whether the law is satisfactory in its provisions, whether it is readily obeyed by those upon whom duties are imposed by it, and mention any improvements you would suggest as to its requirements.

3. Is the material received in good condition?

4. What disposal is ultimately made of the remains?

5. Please state what means are employed to preserve anatomical material for the purposes of dissection or operative surgery. If injections of preservative fluids are used,

state their composition and the methods of use, at what point injections are made, whether at the heart or in the large arteries, and their effect in accomplishing the preservation, with any changes in the color or character of the tissues. What length of time can material be used in dissection employed by you? If preservation by means of cold storage is employed please state the cost of the machinery which it was necessary to construct for this purpose, and what means are taken to prevent decomposition after the subject is placed upon the table for dissection.

6. Please state the cost by the method employed by you, for the reception, the injection and preservation of each subject.

7. Do you obtain an adequate supply of material for the purposes of anatomical instruction? How many students are assigned to each subject, and what is the method of allotment?

8. Please give any further information which you may deem of importance.

This letter was sent to the professors of anatomy in 148 colleges in the United states; 25 in foreign countries, and 25 copies were sent to the medical journals in this country and abroad. Forty-two replies have been received by the committee containing more or less specific answer to the questions propounded in the circular. An analysis of the replies received presents the following results:

1. Anatomical material is received wholly under the provisions of the law in thirty States and countries, in part by law, in seven; and without law, in five.

2. In reply to the second question proposed, fifteen copies of the laws which are in force, have been sent to the chairman of the committee, thirteen of them being the laws of States of this country, and two of foreign countries. With regard to the execution of the law, information was given to the effect that the provisions of the law were satisfactorily complied with in ten, fairly so in ten, not satisfactory in twelve, and no replies were given in ten. In eight the provisions of the law were stated to be obligatory, and in six the provisions were optional. In considering the subject of the report so far as it relates to the collection of anatomical material by law, the committee has confined itself to the examination of and report on the anatomical laws of the States of this country.

3. The report as to condition in which anatomical material was received was that in twenty instances it was good; in twenty-one, fair; and in one, bad.

4. As to the disposition of the remains, in twenty-seven institutions they were reported buried; in ten, cremated; and in four, thrown away.

5. The answers received to the question with regard to the agents employed in accomplishing the preservation of subjects, gave information as to quite a large number employed and in various combinations. An analysis shows that of the agents used carbolic acid stands first, and that it was used not alone but in combination with other agents. Glycerine was reported as an ingredient in the next highest number. It was also employed in combination with other agents. The next in frequency was reported to be arsenic, and this agent was used also in combination. Chloral hydrate and chloride of zinc and bichloride of mercury come next in the order of use. Alcohol, either pure or in combination, carbonate of potassium, bicarbonate of sodium, chloride of sodium, methyl spirit, formalin, nitrate of potassium, brown sugar, boric acid, were reported as used in numbers varying from four to one. The preservation of subjects by cold storage was reported in five instances. Some of the agents above noted were used in combination to preserve the subject, which had been kept in cold storage after it was placed upon the table for dis-

section. In one instance the following plan was reported: Injection with carbolic acid one and a half pints, glycerine six pints, with alcohol one and one-half pints. After the injection, directions were given to paint the subject daily for fourteen days with carbolic acid, one part to glycerine six parts, and then place it in an air tight box over a pan of methylated spirits. Perfectly satisfactory results were reported to have been obtained by this method, both as regards the character of the tissues and the absence of odor. Subject keeps indefinitely. Chloride of zinc, a fifty per cent. solution of neutral reaction was reported as an agent used successfully in preserving subjects, but had the objection of unfavorable action on the tissues, causing hardness and change in color. If subject is not required for immediate use it was placed in a saturated solution of salt, forming a strong brine. If immersed for a long time in the brine the subject requires to be soaked in water for a period of twenty-four or forty-eight hours, in order to soften the tissues.

A number of formulæ were given, among them Wickersheim's Formula, consisting of three thousand parts of boiling water, one hundred and nine parts of alum, twenty-five parts of chloride of sodium, twelve parts of nitrate of potassium, sixty parts of carbonate of potassium, ten parts of arsenious acid, when cool filter, and to ten parts of the liquid thus obtained add one part of methylic alcohol and four parts of glycerine.

Van Vetter's Formula: Seven parts of glycerine, one part of brown sugar and one-half part of nitrate of potassium.

Langer's Formula: One hundred parts of glycerine, fifteen parts carbolic acid, eleven parts of alcohol.

Empersonne's Formula: Chloral Hydrate five hundred grains, glycerine two and a-half litres and distilled water.

Among the formulæ reported, arsenic was an ingredient in a large number, and in the following combinations: 1. Arsenic (pure) eleven and one-half pounds, carbonate of potassium twenty-one pounds, crude carbolic acid and glycerine each two pints, with distilled water sufficient to make one gallon. 2. One pound of arsenic, one pound of bicarbonate of soda, one pint of salt, six quarts of water. 3. Injection of arseniate of potash, mixed in large quantity with liquid soap. 4. Arseniate of soda, in saturated solution, one gallon; carbolic acid, eight ounces; glycerine, one-half pint. The above formulæ afford examples of the use of arsenic, either in the form of arsenious acid, arseniate of potassium, or arseniate of sodium. As a rule, it was combined with some salt of potash, carbolic acid and glycerine. In a few instances it was reported as being used alone in solution.

Carbolic acid appears in a large number of the formulæ reported in use. In most instances in combination with arsenic, some salt of potash or soda or bichloride of mercury. In few instances it is reported as being used alone.

Bichloride of mercury is also reported as largely used alone or in combination with arsenic, salts of potash or soda, carbolic acid and glycerine; one formula being one five-hundredth solution of bichloride of mercury in mixture of water, glycerine and al cohol; another, a mixture of bichloride oi mercury, glycerine, carbolic acid and spirit. The bicarbonate of potash, bicarbonate of soda, nitrate of potash, as well as the chloride of sodium, appeared in a number of the combinations employed. They are not reported as possessing sufficient preservative power which would permit them to be used alone.

Glycerine appears to be a favorite agent, as it forms a part of a large number of formulæ. The same may be said in a very less degree however, with regard to the use of alcohol.

Formalin is reported in two instances,

in one of which it was used in connection with the preservation of human subjects, and another in the preservation of an animal. In the latter instance the agent was used in the proportion of one part to two hundred parts of water. The animal was injected with the solution thus prepared and the body was placed in a tank with a large quantity of fluid which was changed after a period of one week, then after a period of three weeks and strengthened from time to time by the addition of a little formalin. Experience obtained in this case was that, to make the injection of this agent effective, the body should be thoroughly injected, washing out the blood if possible, and if the body is not to be dissected at once it should be placed in a receptacle capable of being sealed up to prevent the escape of formalin, and to prevent the formation of mould it should at all times be covered by the solution. The cost of the formalin was stated to be $1.65 per pound package for a forty per cent. solution.

5. As to the point in which injections were made there were reported two in the heart, nineteen in the common carotid artery, and six in the common femoral artery. As to the condition of the tissues after injection but few replies were received and these were not satisfactory. With regard to the time in which material can be kept and used in dissection, the replies include periods from three weeks to one year. Five reported having used or were using the method of preservation by cold storage. The cost of the plant being from $500 to $3,000.

6. The cost of receiving and preserving material is stated to be from $1 to $25 per subject.

7. In fifteen cases the supply of material is stated to be sufficient and in fifteen not sufficient. In a number it was stated to be adequate, but more could be used if obtainable. The number of students were reported as assigned to each subject to vary from four to sixteen.

While the committee feels that the information gathered through the circular letter was not in some respects sufficiently specific to enable it to arrive at definite conclusions, upon the subject under consideration, yet it believes that certain statements may be made and conclusions deduced which will be of value to teachers of anatomy and those interested in the collection and preservation of anatomical material.

The committee regards it in every way as a matter to be most favorably commented on that out of the 42 replies from institutions 30 contained information that anatomical material was obtained for the purposes of instruction under the provisions of the law. An examination of the copies of the law which were sent to the chairman of the committee shows them to be defective in many respects, giving evidence in the provisions incorporated in the laws of a strong feeling on the part of legislators against the enactment of laws controlling the disposition of dead human bodies for the purpose of dissection. This feeling has no doubt its origin in a fear that by so doing they will expose themselves to criticism, if not to censure, by their constituents. This sentiment it believes can be largely changed by the influence exerted upon the public mind by the members of the medical profession. In every community it should be the effort of the medical profession to educate public opinion upon this point. To place before the public the great necessity which exists for the use of dead human bodies in providing the proper instruction of students in medicine, and the great protection afforded the citizens in each State by the enactment of laws which will regulate the supply of anatomical material and thus afford protection to the dead and prevent the desecration of their resting places.

With regard to the protection which a properly framed law affords to the community, it may be stated that it is within the information of the committee and also it may be said of the public that the body of a member of the family of one of the highest officers of the land was found in the dissecting room of a medical college. In the State in which this family resided there was at that time no Anatomical Law in existence. Since then one has been enacted, and the repetition of such an occurrence as that referred to is not possible under its provisions.

Since the preparation of this report was begun it has been reported in the daily papers that a physician residing in one of the Western States has been convicted for the desecration of a grave, by the removal of the body which it contained, and which was to be used for dissection, and has been sentenced to imprisonment for a term of three years. In the State in which this occurred, there is, so far as the committee knows, no Law governing the use of dead human bodies for the promotion of medical science. These instances afford, the committee thinks, in a very forcible manner, evidence of the protection which would be furnished to both the community and the profession by the provisions of a properly framed Anatomical Law. Attention has been called to the fact that in a number of existing laws their provisions on examination were found to be defective. In some instances they were so inadequate as to render the execution of the law practically impossible, and in other cases to make the law inoperative. On this point the committee feels it proper to express an opinion to the effect that the requirements of any law which is to be enacted should be made compulsory, and not optional, as to performance of duty on the part of public officers. It thinks that sufficient experience has been obtained in the effort to secure compliance with the terms of Anatomical Laws to make it evident that under such conditions only can the proper supply of Anatomical material be obtained. In any law enacted it also believes that proper protection should be afforded the public as well as the profession in strict specification as to the right of claim for burial. This right should be limited to relatives either by blood or marriage.

In this way claims made by organizations and individuals moved by feelings of sentiment would be disposed of. In almost all States, if not indeed in all, legal provisions are in force which control the burial of the bodies of certain individuals, notably war veterans.

With regard to any other claims by organizations or individuals, it would be proper to leave them to the discretion of those having charge of the execution of the requirements of the law. A spirit of conciliation and a regard for public sentiment should always actuate those concerned in the execution of the law, in order, so far as possible, that any feelings of antagonism or hostility should be removed. As stated above, it should be the duty of members of the medical profession to educate public sentiment and obtain in every State enactment of a law which will control the use of dead human bodies for the promotion of medical science. At this time of writing the daily papers contain an account of the action by the Governor of a Western State, who has been compelled to call upon the military force to protect a medical college, which has been threatened by a mob. In this case the trouble has been caused by the discovering in the dissecting room of the college of bodies removed from a cemetery adjacent to the city in which the college is situated. Here is plainly made manifest the necessity of a law to protect both the public and the profession. An examination of the laws now in force in the States in this country leads the committee to the belief that the law of the State of Pennsylvania is the best, in the fact that it includes in its terms all the provisions necessary to compel compliance on the part of public officers and to protect the citizens of the Commonwealth in all of their rights. It is also observed in the examination of the laws of other States that many of them have been founded upon this law, but in no instance have all of the provisions of the law been incorporated. This is possibly to be expected, as the conditions existing in each State control the actions of the legislative bodies in the framing of laws. A copy of the law of the State of Pennsylvania is appended to this report, and may be examined by the members of the Association.

With regard to the disposition of the remains left after dissection, the committee feels it proper to advise that so far as possible they should be decently interred. Under any circumstance the committee thinks that it is not in keeping with the proper sentiment to dispose of them in the manner in which it is feared it is sometimes done. The retention of bones in some instances for the purposes of study and instruction and for the preparation of articulated skeletons is necessary and sanctioned.

With regard to the preservation of anatomical material by the injection of chemical agents or by cold-storage method, the committee feels that the information received is not as specific and comprehensive as desired. The agents reported to be in use, either alone or in combination, are such as are well known to the teachers of anatomy. There is apparently no conclusive evidence that any one of the agents alone, or in combination, accomplishes all that is desired in the way of the perfect preservation of anatomical material. Perfect preservation includes not only freedom from decomposition, but the maintenance of the tissues in a normal condition as nearly as possible, and the existence of these conditions for such length of time as may be necessary in the storage of subjects on one hand and the time required for the work of actual dissection on the other hand. In many institutions it is necessary to collect during a period of the year, and that the most unfavorable season, so far as temperature is concerned, a number of subjects which shall be kept in a state of preservation for a number of months, so that they may be, in every respect, suitable for dissection. To accomplish this it is necessary to employ an agent which will not only prevent decomposition, but also to provide some means to so keep the subject that it may be maintained in this condition of preservation without material change in the color or character of the tissues. These ends are to be obtained, it is also to be observed, within what may be regarded as a reasonable cost. To accomplish the latter object it is manifest that one agent should be used rather than a combination of agents. For instance, the use of arsenious acid or bicloride of mercury, both of which are inexpensive, will provide a means of preservation at no very great cost. When these agents, however, are used in combination with glycerine, rectified spirits, or methylic alcohol, the cost will be materially increased and the storage of the subjects, thus injected, in alcohol or other agent of similar character, will add to the expense. The committee is not able to say from the information received that any of these agents will preserve anatomical material for a number of months. Undoubtedly solutions of bicloride of mercury, arsenic or carbolic acid, will prevent the occurrence of decomposition for a limited period of time, sufficient under ordinary circumstances for the complete dissection of the subject, but no evidence was adduced that these agents, when injected into a subject which was to be stored in a saline solution for a number of months, would be effective. The use of salts of potassa is advised in a number of instances, and, as is well known, they are of value in combinations, the effect being not only in a slight degree preservative, but is also manifest on the color of the tissues. The use of arsenic solutions is objected to by students on account of the irritation of the fingers which is produced. While there may be a few instances in which this objection becomes a matter of serious importance, it may be regarded as of minor importance in a great majority of cases. The objection against the use of glycerine is the production of mould, which occurs as the result of the hygroscopic action. The expense attending the use of alcohol is such as to forbid its employment in any large quantity for injection or storage purposes. Formalin is reported as effective as a preservative and storage agent, but its cost is a strong objection against its use. The committee believes that the method of preservation by means of cold storage is the best which could be employed, but the question of expense of the introduction of a plant necessary for this purpose is a very serious one. In cities where more than one medical institution is situated, it seems feasible to have a central plant in which subjects required in all the institutions can be stored, with the division of expense made amongst those entering into the arrangement. As to the time in which subjects should be injected which are kept in cold storage plants, it is desirable that this should be done prior to their deposit. They will be ready to place at once upon the table, and it is believed the injections can be better made before deposit rather than after they have remained some time under the influence of the cold.

Reference is made to the use of the solution of chloride of zinc as a preservative agent of value, especially where it is necessary to collect subjects during the summer months, and to keep them in a solution of a salt. Solutions of chloride of zinc will, without doubt, not only prevent but arrest decomposition. The bleaching properties which it possesses and which it exerts upon the tissues is a very serious objection. This agent is used largely, if not, altogether in the medical institutions of Philadelphia, to which are supplied each year over seven hundred subjects. It is used as an injection in the proportion of one-half to one-third of a fifty-per cent. of solution of neutral reaction, a subject of average weight requiring from four to six quarts.

In the replies given as to the cost of the reception, preservation and injection of subjects a wide difference is observed. It is evidently impossible, unless subjects are transported without cost, to reduce the cost per subject for reception, injection and preservation to $1.00 each. Under the provisions of a well framed law, it is believed that the delivery of subjects should not exceed as an average from $5.00 to $8.00, and the injection and preservation should be accomplished by an additional expenditure of $5.00, making the cost of each when placed upon the table about $12.00.

Less than one-half of the replies received as to the supply of anatomical material contained the statement that the supply was adequate. In an equal number the supply was stated to be not sufficient and the remaining number reported that more subjects could be used if obtainable. The conclusion to be deduced from these statements is manifestly to the effect that the supply of anatomical material in our medical institutions is not as great as it should be.

The number of students assigned to each subject were stated in the replies received to vary from four to sixteen. Here again, it is to be observed, a wide difference is expressed. The number on one hand to be too small to obtain the proper economy in the use of material, and on the other hand too large to secure the full instruction neccessary. It is to be observed that the manner in which instruction is imparted will modify the statements above made.

CONCLUSIONS.

1. Anatomical material for the promotion of medical science should be obtained wholly under legal enactment. The provisions of the law should be compulsory upon all officers of State and county institutions and municipal governments.

2. Of the anatomical laws which are in force in this country, the committee is of the opinion that the law of the State of Pennsylvania is the best. It is framed in such manner as to provide under a strict execution of its requirements anatomical material for the promotion of Medical Science and prevents the desecration of the resting place of the dead.

3. The committee believes it would contribute to the best interests of anatomical teaching in this country if action was taken by this association to secure the enactment in every State of a law controlling the collection and distribution of anatomical material and recommends such action.

4. The committee finds itself unable, from the information which has been received, to arrive at any definite conclusions with regard to the best means for accomplishing the preservation of anatomical material for the purposes of dissection. Many of the agents reported in the communications received have been long in use, and to a greater or less degree have been employed successfully in securing preservation of anatomical material, but not with all the conditions which are deemed as essential in perfect preservation, and those which afford the best results in dissection. Preservation by means of cold storage it believes to be a method which approaches nearest to perfection, and it should be arranged upon such a plan as will admit of the retention of anatomical material, under the influence the low temperature during dissection.

(*Signed.*) J. EWING MEARS,
J. D. BRYANT,
THOMAS DWIGHT.

NOVEMBER 19, 1895.

The following amendment to the report was adopted: "That Professors of Anatomy be requested to inform their students concerning the laws upon the subject of anatomical material, and request these students to use their influence with the authorities in their respective places of residence to increase the quantity of anatomical material by making available much that is now withheld, either from neglect or indifference."

ANATOMICAL LAW OF THE STATE OF PENNSYLVANIA, ENACTED JUNE 13, 1883.

For the promotion of medical science by the distribution of and use of unclaimed human bodies for scientific purposes through a board created for that purpose, and to prevent unauthorized uses and traffic in human bodies.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same:* That the professors of anatomy, the professors of surgery, the demonstrators of anatomy, and the demonstrators of surgery of the medical and dental schools and colleges of this Commonwealth, which are now or may hereafter become incorporated, together with one representative from each of the unincorporated schools of anatomy or practical surgery within this Commonwealth in which there are, or from time to time at the time of the appointment of such representative shall be, not less than twenty-five scholars, shall be, and hereby are constituted a board, for the distribution and delivery of dead human bodies hereinafter described, to and among such persons as under the provisions of this Act are entitled thereto. The professor of anatomy in the University of Pennsylvania at Philadelphia shall call a meeting of said board for organization at a time and place to be fixed by him within thirty days after the passage of this Act. The said board shall have full power to establish rules and regulations for its government, and to appoint and remove proper officers, and shall keep full and complete minutes of its transactions, and records shall also be kept under its direction of all bodies received and distributed by said board, and of the persons to whom the same may be distributed, which minutes and records shall be open at all times to the inspection of each member of said board, and of any district attorney of any county within this Commonwealth.

SEC. 2. All public officers, agents, and servants, and all officers, agents, and servants of any and every county, city, township, borough, district, and other municipality, and of any and every almshouse, prison, morgue, hospital, or any other public institution having charge or control over dead human bodies required to be buried at the public expense, are hereby required to notify the said board of distribution, or such person or persons as may from time to time be designated by said board, or its duly authorized officer or agent, whenever any such body or bodies come into his or their possession, charge, or control, and shall, without fee or reward, deliver such body or bodies, and permit and suffer the said board and its agents, and the physicians and surgeons from time to time designated by them, who may comply with the provisions of this Act, to take and remove all such bodies to be used within this State for the advancement of medical science; but no such notice need be given, nor shall any such body be delivered if any person, claiming to be and satisfying the authorities in charge of said body that he or she is of kindred or is related by marriage to the deceased, shall claim the said body for burial, but it shall be surrendered for interment, nor shall the notice be given or body be delivered if such deceased person was a traveller who died suddenly, in which case the said body shall be buried.

SEC. 3. The said board, or their duly authorized agent, may take and receive such bodies so delivered as aforesaid, and shall, upon receiving them, distribute and deliver them to and among the schools, colleges, physicians and surgeons aforesaid in manner following: Those bodies needed for lectures and demonstrations by the said schools and colleges, incorporated and unincorporated, shall first be supplied, the remaining bodies shall then be distributed proportionately and equitably, preference being given to said schools and colleges, the number assigned to each to be based upon the number of students in each dissecting or operative surgery class, which number shall be reported to the board at such times as it may direct. Instead of receiving and delivering said bodies themselves, or through their agents or servants, the board of distribution may from time to time, either directly, or by their authorized officer or agent, designate physicians and surgeons who shall receive them, and the number which each shall receive. Provided always, however, that schools and colleges, incorporated and unincorporated, and physicians or surgeons of the county where the death of the person, or such person described, takes place shall be preferred to all others. And provided, also, that for this purpose such dead body shall be held subject to their order in the county where the death occurs for a period not less than twenty-four hours.

SEC. 4. The said board may employ a carrier or carriers for the conveyance of said bodies, which shall be well enclosed within a suitable encasement, and carefully deposited free from public observation.

Said carrier shall obtain receipts by name, or, if the person be unknown, by a description, for each body delivered by him, and shall deposit said receipt with the secretary of the said board.

Sec. 5. No school, college, physician, or surgeon shall be allowed or permitted to receive any such body or bodies until a bond shall have been given to the Commonwealth by such physician or surgeon, or by or in behalf of such school or college, to be approved by the Prothonotary of the Court of Common Pleas in and for the county in which such physician or surgeon shall reside, or in which such school or college may be situate, and to be filed in the office of said Prothonotary, which bond shall be in the penal sum of one thousand dollars, conditioned that all such bodies which the said physician or surgeon, or the said school or college, shall receive thereafter shall be used only for the promotion of medical science within the State; and whosoever shall sell or buy such body or bodies, or in any way traffic in the same, or shall transmit, or convey, or cause to procure to be transmitted or conveyed said body or bodies to any place outside of this State shall be deemed guilty of a misdemeanor, and shall, on conviction, be liable to a fine not exceeding two hundred dollars, or be imprisoned for a term not exceeding one year.

Sec. 6. Neither the Commonwealth, nor any county or municipality, nor any officer, agent, or servant thereof, shall be at any expense by reason of the delivery or distribution of any such body, but all the expenses thereof, and of said board of distribution, shall be paid by those receiving the bodies, in such manner as may be specified by said board of distribution, or otherwise agreed upon.

Sec. 7. That any person having duties enjoined upon him by the provisions of this Act, who shall neglect, refuse, or omit to perform the same as hereby required, shall, on conviction thereof, be liable to fine of not less than one hundred nor more than five hundred dollars, for each offence.

Sec. 8. That all Acts or parts of Acts inconsistent with this Act be and the same are hereby repealed.

Philadelphia, January 1, 1889.

In accordance with the requirements of the above law the Anatomical Board of the State of Pennsylvania was organized July, 1883, for the purpose of carrying it into execution. The attention of all State, county and municipal officers charged with duties under the law is directed to its requirements. Boxes containing bodies should be addressed to George Willie, Philadelphia, and should be delivered to the agent of the express company at the station nearest to the place from which the body is sent. The charges paid by the Board for transportion to the railroad station vary from $1.00 to $2.50 in accordance with the distance. These charges will be paid by the agent of the express company, and collected from the Board by the agent in Philadelphia.

SEVENTH ANNUAL MEETING OF THE AMERICAN FOLK-LORE SOCIETY.

The American Folk-lore Society held its seventh annual meeting in Philadelphia on Friday and Saturday, December 27 and 28, 1895. Although the attendance was rather slim, the number and the value of the papers presented made the session an interesting one. The President, Dr. Washington Matthews, opened the meeting with an address on the poetry and music of the Navahoes. He brought out very clearly the misconception of superficial observers who have not had the opportunity to enter into the spirit of Indian life, and consequently described the primitive tribes as void of poetic or musical feeling. The examples given by the speaker are ample proof that the Navahoes possess a well-developed poetry. In a supplementary paper by Professor J. C. Fillmore the characteristics of Navahoe music were described, which showed that in this case also harmony is the underlying principle of primitive music.

Dr. Robert Bell, the indefatigable explorer, to whose zeal we owe much of our knowledge of the topography and geology of northern Canada, related five Algonquin myths which he collected in the region between Ottawa River and Hudson Bay. These have their close analoga among other tribes of the same stock. Magic and medicine came in for a considerable share of attention in the papers read on the first day of the proceedings. Mr. Stanbury T. Hagar treated the Micmac of Nova Scotia from this point of view, while Dr. J. H. McCormick described the medicine myths of the Cherokee, and Mr. Heli Chatelain made an interesting contribution on the customs of the natives of West Africa.

On the second day a number of papers were read referring to current superstitions of the whites in America. Mr. Robert M. Lawrence presented a vast amount of information on the folk-lore of the horseshoe, in which he dwelt upon the superstitions, referring to its form and material, and those referring to the place at which the horseshoe is used in order to secure good luck. Mr. W. W. Newell contributed a review of a collection on moon superstitions in America made by Mrs. Fanny Bergen. Dr. D. G. Brinton showed how the tendency to displace sacred words by others has led to a curious development of 'cuss words' in America.

A very comprehensive review of the customs of the Spanish in the Rio Grande Valley was presented in a paper by Captain John Bourke on 'Arabic Survivals in the Rio Grande Valley.' Dr. F. Boas discussed the dissemination of tales in America, basing his argument on a comparative study of the myths of the Indians of the North Pacific Coast. A noteworthy myth of the Navahoes was told by Dr. Matthews, in which the principle underlying the secret societies of this tribe was brought forward most clearly. This seems to be identical among all the tribes of North America: An ancestor of the Indians is taken away by certain supernatural beings and is taught by them the secrets and particularly the songs of the society. In conclusion, Dr. McCormick read a paper on negro folk-lore in America.

The work of the Folk-lore Society has shown a marked advance of late years. Although the membership has not as much increased as might be desired, the Society has been able to publish, in addition to its journal, a number of supplementary volumes dealing with special subjects, and has thus succeeded in making valuable contributions to the study of American folk-lore. This work is being carried on as energetically as possible, and in the coming year the Society expects to publish two new volumes, one on current superstitions among the English speaking people of North America, by Mrs. Fanny Bergen, and a second one, a full collection of Navahoe myths, by Dr. Washington Matthews. The Society derives much of its support from local societies which are being organized in a great number of the larger cities of our continent, but most of its success is due to the unflinching perseverance of its Secretary, Mr. W. W. Newell.

The officers elected for the coming year, are: Captain John Bourke, President; Mr. Stewart Culin, First Vice-President; Dr. F. Boas, Second Vice-President. The next annual meeting will be held in the Christmas week of this year, in Baltimore, Md.

F. B.

ALASKA AS IT WAS AND IS, 1865–1895.

(Concluded.)

AT the time of my first visit and until very recently the sole productive industry of the Aleut people consisted in the sea-otter hunting and the fur-seal fishery. Much of their subsistence was and is obtained from the natural products of the region—fish, wild fowl, and the flesh of marine mammals. The custom of preparing clothing from the skins of birds and animals has long been abandoned. The Aleut and his family now dress in clothing of wool or cotton, burn kerosene in an American lamp, and cook their food on an iron stove. The barábora or native hut, built of sod and stones, has been generally replaced by a frame cottage, and the means for supplying these artificial wants has been obtained from the income derived from the seal and sea otter. Now that these animals are approaching extinction, at least from a commercial standpoint, the question how to provide even the modest income needed for these people is a serious one. While it is not yet settled that the half-starved Eskimo of the northern coast will adopt the new mode of life necessitated by the care and maintenance of large herds of tame reindeer, and the success of that experiment is still questionable, there is no doubt in my mind that the introduction of the deer into the Aleutian chain is not only perfectly practicable, but that it offers the only solution of the problem of providing for the Aleuts which seems to possess the elements necessary for success. There are no predacious animals to molest the deer, like the wolves of the mainland; there is an abundant supply of forage, and the climate and conditions are those that the animal is known to thrive in. A herd introduced a few years ago into Bering island, on the Russian coast, and simply let alone and protected from dogs, has increased very much in number and will soon afford skins and tallow for export. There is no obvious reason why on most of the Aleutian Islands equally good results should not be obtained. Some few deer were introduced upon the island of Amaknak, in the bay of Unalashka, a few years since, but they were the property of whites, not natives, were not protected from the numerous dogs of an adjacent settlement, and have not thriven.

When the time comes, and it seems not far away, when the natives realize that they must depend on the deer to replace the vanishing fur animals as a source of income, and when they can acquire property in deer, I believe the result will be all that could be wished.

In closing this summary of early conditions in the Territory and of the events which enabled them to be observed, it may not be out of place to summarize also the results of the scientific work of those years. Of course, only the more important points can be alluded to. As the Western Union Telegraph Expedition ended by a withdrawal from the country, and was the occasion of a large expenditure of money with no return to its promoters, no general report was ever officially prepared, and the work of the scientific corps was made known piecemeal in various technical journals. The published results were associated in the minds of students with the individual authors rather than with the expedition as a whole. The subsequent work under the auspices of the Coast Survey, which in fact grew out of the work done or attempted in the earlier exploration, has been, so far as it was geographical, regarded very naturally as incidental to the usual work of that bureau, and so far as it has been of other sorts has not been connected in the public mind with any organization in particular. The fact that the Revenue Marine, the Army and Navy, the Signal Service and several unofficial organizations or individuals have carried out praiseworthy explorations with most excellent results has led to the further obscuration of the earlier work as a connected whole. I believe no one of those engaged in it has yet attempted to enumerate the results, either general or scientific, directly or indirectly consequent upon the expedition. The present summary may therefore serve a useful purpose.

The most important result which indirectly came about from the explorations by our parties was the acquisition of Alaska by the United States. While the transfer might have been proposed and the question discussed if there never had been any telegraph expedition, yet I believe, in view of the opposition which existed in Congress and the cheap ridicule of part of the daily press, that if it had not been for the interest excited by the expedition and the information which its members were able to furnish to the friends of the purchase the proposition would have failed to win approval.

But, leaving such questions apart and considering merely the scientific results, the expedition made weighty additions to geographical knowledge. To it we owe the first mapping of the Yukon from actual exploration, adding to the list of American rivers one of the largest known. Old maps of North America made the Rocky mountains extend in nearly a straight line northward to the Polar sea. Our explorations showed that the mountains curved to the westward, leaving a gap to the northward through which the Canadian fauna reached to the shores of the Pacific and Bering sea. The general faunal distribution of life at this end of the continent in its broader sense was settled then and there. A general knowledge of the country, till then practically unknown except to a few fur traders, was obtained and made public. To the Coast Survey work of 1871–'74 we owe some forty charts, a large proportion of which are of harbors or passages never previously surveyed. In preparing a Coast Pilot of southeastern Alaska, while that part of it useful to navigators was in the nature of things rapidly superseded, yet the work, being conscientious and thorough in the matter of names, practically settled the geographic nomenclature of that region for all time. The myth of a branch of the Kuro Siwo or Japanese warm current running north through Bering sea and strait and producing open water in the Polar sea still lingers in some dark corners of geographic literature; but our researches, covering actual observation, the whole literature, and scores of old manuscript logbooks, conclusively show that there is no such current as that referred to, and that the currents which do exist have no connection whatever with the Japanese stream. Meteorological observations were kept up in all those years, and afterward a complete synopsis of all the recorded meteorological data for that region was prepared and issued by the Coast Survey with abundant illustrations. One of the results of the magnetic observations made by our party, in the endeavor to correct the discrepancies between the variation of the compass needle as shown on the charts of Bering sea and strait and those observed by present navigators, was the discovery that the needle had reached its easternmost elongation and had for some time been receding in the amount of its variation. In gathering confirmatory data during 1874 and 1880 more than forty stations in all parts of the Territory were occupied. As in the case of the meteorology, the literature and all practicable sources were ransacked for magnetic records,* and these, with our own observations, were utilized in the excellent discussions of Alaskan magnetism by Dr. C. A. Schott.

In geology we were tutored before sailing in 1865 by Prof. Agassiz and carried with us a written schedule of observations to be made on the glaciers. Our explorations showed that north of the Alaskan moun-

*This work was almost entirely done by Mr. Marcus Baker.

tains, as in some parts of Siberia, there are no glaciers, and there has been no glaciation in the ordinary sense, but that in its stead we have the singular phenomenon of the Ground ice formation, a state of affairs in which ice plays the part of a more or less regularly interstratified rock, above which are the clays containing remains of the mammoth and other animals, showing that they became extinct not because of the refrigeration of the region, but coincidently with the coming of a warmer climate.

In anthropology, in addition to large collections obtained from the living tribes, vocabularies, etc., the names and boundaries of all the tribes were obtained for the first time, the Eskimo were shown to exist on the Asiatic coast as immigrants driven by war from America, and a very ancient confusion of these people with the Asiatic Chukchi was definitely cleared up. The data obtained in regard to the various branches of the Eskimo stock brought welcome confirmation to the theory of Rink on the origin of this people—a theory which would probably have been by this time more widely known if it had been more sensational and less scientific.

The patient examination of many village sites, shell heaps, and middens throughout the Aleutian chain resulted in the discovery that the successive strata, judged by the implements found in them, showed a gradual progress in culture from that of the lowest, a crude Eskimo type, to that of the uppermost stratum, which contained the evidences of Aleut culture of the type immediately before their subjugation by the Russians. This was, I believe, at that time the first instance in which the paleontologic method, if I may call it so, had been applied to the study of American shell-heaps.

In biology the first object of the work planned by Kennicott had been the determination of what constituted the fauna and flora, and from that knowledge the determination of the relations between the Asiatic and American assemblies. This was accomplished in essentials, though it need not be said that the details will still supply an opportunity for study for many a year to come. The enumeration of the greater part of the population of mammals, birds and fishes has been accomplished and the plants have been fairly well collected, so that we know that the fauna and flora, deduction being made of circumboreal species, are essentially American and not tinctured to any marked extent with Asiatic ingredients. Among the lower animals the brachiopods, hydroid zoöphytes and corallines; part of the sponges; the limpets, chitons and nudibranchs among the mollusks, have been monographically studied. The crustacea, insects, and a large part of the the mollusks yet remain to be worked up in a similar manner.

To close the record of achievement, I may mention the biblography of Alaskan literature, prepared by Mr. Baker and myself, which, up to May, 1879, when it went to press, comprised 3,832 titles in eleven languages. Since it was published by the Coast Survey nearly as many more have been accumulated, and the list probably will continue to increase from year to year.

Since my field work closed, in 1880, Alaskans have not been idle. The prospector has invaded the recesses of the land, and surveys, explorations and mountaineering have been almost constantly carried on. The tourist has discovered the country and written books which, although they have the resemblance of one pea to another, have nevertheless carried tidings of Alaska to most corners of the Union. Alaska in one sense is no longer unknown, and she is even beginning to be understood and appreciated. The missionary has been up and down in the land, and has done much good in many ways, not without occasional mistakes.

It was, therefore, with curiosity as well interest that I returned to the Territory last May, after an absence of fifteen years. In looking back on the summer's experiences, a comparison between the Alaska of 1865 and that of 1895 naturally suggests itself. I was rash enough twenty-five years ago to indulge in prophecy as to the future of the Territory. I did not count on the inertia of Congress or the stupidity of officials, as I might now. Nevertheless progress has been made, and a summary of present conditions, perhaps even a peep into the future, is not inappropriate at this time.

Since 1865 the fur-seal fishery has risen, produced its millions, and declined to a point where its close in a commercial sense may almost be predicted. The first fisherman sought the cod in that year, and a modest fleet has kept the business going ever since, with more or less fluctuation in the catch. The salmon canner was then unknown, but has since invaded nearly every important fishing site. The placer miner has developed and exhausted the gold of the Stikine region, and pushed on to the head waters of the Yukon and its affluents. The clink of the drill and the monotonous beat of the stamp mill are familiar sounds on the quartz ledges, which in 1865 lay peacefully under their blankets of moss. The whaling fleet has laid its bones on the sandy bars of the Arctic coast, while the innovating steam whaler has pushed its way past Point Barrow into the very fastness of the ice at Herschel island, to find, in its turn, its occupation gradually passing away. The imperial sea otter is on the way to becoming a memory, and the Aleuts, his persecutors, are not unlikely to follow him.

As regards the inhabitants of the Territory, a complete change is conspicuous. Some thousands of white fisherman, hunters, miners and prospectors are now scattered along the coast and rivers, on the whole a hard-working, orderly set, with here and there a rascally whisky smuggler or a stranded gentleman. Apart from a few mining camps, the parasites who live by the vices of others are few. A country where he who would live must work is not attractive to them. Cut off from direct contact with the rest of the United States, Alaska is really a colony and not a frontier territory in the sense usually understood. As such, its needs should have been the subject of study and appropriate legislation, the neglect of which by Congress so far is bitterly and justly resented by the entire population. Into political matters I shall not enter, but must observe that among the numerous ill-paid officials few are well prepared to handle all the difficult questions presented in such a community, and the executive, such as it is, is without the legal authority or the proper facilities for governing or even visiting the greater part of the region it is supposed to control. The state of the law is uncertain, the seat of authority obscure, divided illegitimately between naval officers, the revenue-cutter service, and a powerless Governor, who, whatever his wishes and intentions, is not permitted by the law to control anything. If it were not for the orderly character and good sense of the white population, the Territory might easily become a pandemonium. This condition of things is disgraceful, and reform is urgently needed.

The change in the native population of southeastern Alaska is very marked. In a general way a similar change has taken place all over the Territory. The primitive condition of the natives has almost wholly disappeared. The turf-covered hut has given way to frame shanties; log houses are rarely built; the native dress has disappeared, replaced by cheap ready-made clothing; native manufactures, utensils, weapons, curios, all are gone, or made only in coarse facsimile for sale to tourists; the native buys flour and tea, cooks his salmon in a frying pan, and catches his cod or halibut with a Birmingham hook and a Gloucester line. In the whole of southern Alaska, thanks to the schools, the children and many young people speak fairly good English. If the present influences continue, another generation will see the use of English universal and the native languages chiefly obsolete. The day of the ethnological collector is past. Southeastern Alaska is swept clean of relics; hardly a shaman's grave remains inviolate.

In other parts of the Territory the same is more or less true. The native population is focusing about the commercial centers. The people gather where work and trade afford opportunities, and I have seen more than one pretentious church standing empty among the abandoned houses of a formerly prosperous village. There is some admixture of blood in marriages between the often attractive 'Creole' women and the incoming settlers. These marriages are often very fruitful, but the pure-blooded natives seem to be diminishing. The Aleuts, whose census is accurately made annually by the Greek Church, are distinctly losing ground, and will doubtless pass away in a few generations. The same is probably true of the Tlinkit people. As we approach the Arctic region, changes of all sorts are less marked and civilization has had less effect. Here the subsistence of the natives presents serious and increasing difficulties. Their natural food supply has been practically destroyed by the whites and by repeating firearms, of which the natives have many. The whales are almost extinct, and the whaling fleet itself is nearly so. The walrus preceded the whale, and the hair seal has never been sufficiently abundant in this region for a sole resource. The chief salmon streams are or soon will be monopolized by the whites near the sea, and the natives of the upper Yukon will go hungry. The present law allows unrestricted fishing to the natives and a close time of one day a week for the whites. The latter hire the natives to fish during the prohibited day, and so the salmon have no close time. Where a salmon stream is monopolized by one firm, they do not usually cut their own throats by taking all the salmon, but where there are several competing firms there is little respite for the fish.

The cod fishery was for some years carried on by two competing firms, who have now composed their differences. They had salting stations on shore, and bought fish at so much a thousand from fishermen, who used small sailing vessels or dories and fished near shore. Now it is found cheaper and, for other reasons, preferable to return to the older system of fishing in the open sea from a sea-going vessel, as on the banks at the East. The preparation of the Alaska fish has often been hasty, careless and inferior to that done in the East; so Alaska codfish, originally of equal quality, are less esteemed commercially than the Eastern cod. For some reason I do not understand the Pacific Ocean at best offers but a small market for fish under present conditions, and so I look to see the codfishing industry develop slowly and perhaps be the last, as it is, in my opinion, the most substantial and important of the resources of the Territory. At present the salmon are commercially more important, but unless more effectively supervised and regulated they will meet with the same fate as the fisheries of California and the Columbia river. There should be a resident inspector at every important fishery, and as the business is carried on for at most two or three months in the year, a vigilant inspection by a cutter or fisheries vessel told off for this especial work would counteract any tendency to bribe the resident inspector. I have seen 3,500,000 pounds of canned salmon taken in one season from one small stream, representing at least 5,000,000 pounds of eatable fish, and it seems that an annual supply of the best fish food like that is worth preserving; but if the work is to be put into the hands of the lowest class of political appointees, instead of intelligent experts, making the offices will not save the fish.

In the matter of furs we may regard the fur seal fishery as doomed. It is probable that few of the pelagic sealers will pay expenses after this season, and two or three years are likely to see the end of the business. It is costing us much more than the catch is worth now, and the most sensible way of ending the matter is generally felt to be the destruction at one fell swoop of all the seals remaining on the islands and the abandonment of the business.

The continental furs, owing to competition between traders, are now selling for nearly their full market value, and little profit can be expected from them. They are also growing more and more scarce, as the high prices stimulate trapping. The natural and satisfactory offset to this would be the establishment of preserves, such as the 'fox farms,' of which mention has been frequently made in the daily press. Many of these have been started, and the multitudinous islands offer opportunities for many more; but the business is hazardous, since there is no protection against poachers, and a very ill-judged attempt has been made by the Treasury, I am informed, to impose, in addition to the annual sum for which the island is leased, a 'tax' of $5 on each fox killed over twenty from each 'farm.' It is doubtful if the Treasury is entitled to tax anybody without the explicit authority of Congress, and a tax of 50 per cent. on the gross value of the product not only is oppressive and exorbitant, but will put a stop to a business which should be encouraged.

The timber of Alaska, though by no means insignificant, is not likely to be much sought for, except for local purposes, for many years. I may point out, however, that there are millions of acres here densely covered with the spruce best suited for wood pulp, and plenty of water power for pulpmills, so that this resource is not without a future.

A forthcoming report of the United States Geological Survey will treat of the existing and prospective mining industries.

To sum up, it may be said that the whaling and sealing industries of Alaska are practically exhausted, the fur trade is in its decadence, the salmon canning in the full tide of prosperity, but conducted in a wasteful and destructive manner which cannot long be continued with impunity. The cod and herring fisheries are imperfectly developed, but have a substantial future with proper treatment. Mineral resources and timber have hardly been touched. No business-like experiment with sheep or cattle on the islands has been tried by competent hands, while the introduction of reindeer, though promising well, is still in the experimental stage. Socially, the Territory is in a transition state, the industries of the unexploited wilderness are passing away, while the time of steady, business-like development of the more latent resources has not yet arrived. The magnificent scenery, glaciers and volcanoes make it certain that Alaska will in the future be to the rest of the United States what Norway is to western Europe—the goal of tourists, hunters and fishermen. Agriculture will be restricted to gardening and the culture of quick growing and hardy vegetables for local use. The prosecution of most Alaskan industries being in untrained hands, failures and disapointment will no doubt be frequent, but when the pressure of population enforces more sensible methods, the Territory will support in reasonable comfort a fair number of hardy and industrious inhabitants.

WM. H. DALL.

CURRENT NOTES ON ANTHROPOLOGY.

RELATION OF THE BRAIN AND SPINAL CORD IN MAN.

SOME interesting facts were developed by Prof. Ranke at the last meeting of the German Anthropological Society, in relation to the relative weights of the brain and spinal cord in man.

It is well known that man has not the heaviest brain of any animal; the whale and elephant have heavier. Nor has he the heaviest in proportion to his weight; some singing birds, various small apes, and the mole have proportionately heavier brains. What Ranke brings out is that the weight of the human brain is much greater in proportion to the weight of the spinal cord than in any other vertebrate; and this, therefore, constitutes an anatomical distinction of man, strongly contrasting him with all other animal forms.

The article of Prof. Ranke may be found in the 'Correspondenzblatt' of the Society.

THE MAN FROM GALLEY HILL.

So long ago as 1888 Mr. Robert Elliott exhumed some human remains from the 'diluvial' gravel at Galley Hill, Northfleet, Kent, England, in immediate contiguity to 'palæolithic' implements. The remains were first described by Prof. Newton before the Geological Society of London, last year. The skull is markedly dolichacephalic, its index being 64; the forehead is low and retreating, the supraorbital ridges prominent; the chin is also retreating; the individual's height, calculated from the femur, was about 1.60 meter. In some respects, the remains were noticeably similar to those found at Spy, Belgium.

It must be said, however, that little value can be attached to these relics. The gravel deposit where they were found is now destroyed; they may have been a later burial in the gravel; years have elapsed since their exhumation during which time the finder concealed the discovery. Mr. Elliott has no one but himself to blame if men of science decline to accept the accuracy of his observations at this date. Let it be a warning to others to be more careful and more liberal.

D. G. BRINTON.

SCIENTIFIC NOTES AND NEWS.

A GIGANTIC ORTHOCERATITE FROM THE AMERICAN CARBONIFEROUS.

IT is a well known fact that the straight-shelled cephalapod was an abundant form of life during Paleozoic times. This is attested by the large number of species that have been described, those of the Orthoceras group alone numbering upwards of twelve hundred. The culmination and greatest expansion of the group was in the Silurian, and from that period it appears to have gradually dwindled in number of species, size and abundance, until at the close of the Paleozoic the form was all but extinct. In the American Silurian some of the shells attained huge proportions; but with the general decline of the group the later ones have heretofore seemed to rapidly become dwarfed until only small unimportant individuals were recorded after the Devonian.

In the Carboniferous a few dimunitive species have been described, none of them being more than a few inches in length. In the Coal Measures of the Mississippi basin the remains found were of rather rare occurrence, imperfectly preserved and of very small size. Seldom did the shells exceed six inches in length, and half an inch in diameter.

Of late years, however, some unusually fine material has been obtained in the black shales of the Lower Coal Measures in the vicinity of Des Moines, Iowa. Several of these shells were so large as to excite considerable wonderment. They were over two feet long and one inch in diameter at the larger end. These were thought to be giants of their kind and day.

Recently there was found in one of the coal mines at Fansler, in Guthrie County, Iowa, about forty miles from Des Moines, an Orthoceras shell of gigantic proportions, by the side of which all the other Carboniferous species of the genus are mere pigmies. This specimen is three inches in diameter; and as it is of the same very slender type as the associated forms it could not have been less than six feet in length, and probably was even longer. The species is *O. fanslerensis.*

CHARLES R. KEYES.

ASTRONOMICAL.

THE last German mail has brought copies of the report made by Prof. Albrecht, of Potsdam, at the last meeting of the International Geodetic Committee on the subject of Variation of Latitude. The report contains much interesting matter. There is a summary of all the observational material gathered since 1890 and arranged in the form of monthly means for each observing station. The results are then discussed in such a way as to lead to a final table in which the difference between the mean and instantaneous latitudes is given for every tenth of a year and for every thirty degrees of longitude. The results are stated to be provisional only, because several of the observatories have not yet furnished definitive reductions of their observations. This want will no doubt soon be supplied. The results of the observations made at Columbia College, New York, which are among those not yet reduced, are particularly needed, according to Prof. Albrecht, because they alone can raise the determination of the *y*-coördinate of the instantaneous pole to sufficient precision. The most important result reached by Prof. Albrecht is summarized in the following words: "The phenomenon of the polar motion proves to be too complicated to admit of complete representation by means of a formula containing several terms. This having been proved, we may regard it as settled that we have at the present time only reached the stage of a first approximation to a knowledge of the phenomena in question. We should regard the problem, therefore, as very far from solved, and must devote to it our full attention."

IT will, perhaps, be of interest to astronomers and others interested in complicated calculations to learn that it is possible now to obtain a computing machine of the very highest capability at a very small price. The 'Brunsviga' machine, made by Ernst Schuster, Schöneberger Ufer, Berlin, costs only seventy-five dollars, and gives a product of thirteen figures. That is to say, two numbers, each containing six figures, can be multiplied together. These machines can be imported duty free by educational institutions. Three of them are in continual use at the observatory of Columbia College, New York, where they give the greatest satisfaction.

H. J.

PHYSICS.

UNDER the title *Ueber die Doppelbrechung der Strahlen Electrischer Kraft* (Wied. Ann. Vol. 56), p. 1, 1895, Mr. Lebedew describes the apparatus and methods of obtaining very short Hertz waves, $\lambda = 0.6$ cm., together with convenient arrangements for showing polarization, interference, rectilinear propagation, reflection and refraction. He was able even to obtain crystals large enough to show double refraction, and constructed Nicols prisms of sulphur crystals cut correctly and set together with a film of ebonite. Using these Nicols he was able to repeat the usual tests between crossed Nicols in light, even producing a plate of sulphur which showed phenomena similar to those with the $\frac{1}{4}\lambda$ mica plate. These very short waves make many experiments not only possible but simple.

MR. K. OLSZEWSKI has applied a method (Wied. Ann. Vol. 56, p. 133, 1895) which he calls the expansion method, to the determinations of low temperatures and has compared the results with those obtained with a hydrogen thermometer. The results are as follows:

Tension of oxygen	Temperature determined by hydrogen thermometer	Temperature of the liquid oxygen determined with the platinum thermometer, using the expansion method,
50.8 atm. (critical pressure)	—118°.8 C. (critical temperature)	—118.° to —119°.2 C. (critical temperature)
32.6 atm.	—130°.3	—130°.
19. atm.		—140°.5
10.2 atm.	—151°.6	—152°.
1.atm.	—181°.4 to —182°.7 (boiling point)	—181°.3 to —182°.5 (boiling point)

W. H.

THE HUXLEY MEMORIAL.

THE general committee report that since the first meeting on the 27th ult., which was fully reported in this journal, two meetings of the executive committee have been held. At the first of these, at which Lord Shand accepted the office of chairman, it was reported that a number of foreigners of eminence had expressed a wish to be associated with the proposal to commemorate Mr. Huxley's distinguished services to humanity. It was resolved, in the first instance, to invite subscriptions from the members of the general committee. At the second meeting, held on Wednesday, it was reported that the subscription, which at the general meeting had amounted to £557, had been increased to about £1,400, and it was resolved that a wider appeal for subscriptions should now be made to the friends and admirers of Mr. Huxley amongst the general public. The honorary secretary stated that in America committees were in the course of being formed to promote the realization of an adequate fund. The committee resolved to communicate, by means of a sub-committee of their number, with Mr. Onslow Ford, R. A., who had the advantage of being well acquainted with Mr. Huxley, in reference to the statue, which it is proposed should be erected beside those of Darwin and Owen in the Natural History Museum, South Kensington. The extent to which the committee may be able to carry out the other intended objects of founding exhibitions, scholarships, and medals for biological research and lectureships, and possibly in assisting the republication of Mr. Huxley's scientific works, will of course depend on the subscriptions which may now be received. These may be sent to the treasurer, Sir John Lubbock, or the bankers, Messrs. Robarts, Lubbock and Co., 15 Lombard street, E. C.; or to the secretary, Professor G. B. Howes, Royal College of Science, South Kensington. The amount received to December 26 is £1,535.

CONCILIUM BIBLIOGRAPHICUM.

WE have now received the official prospectus of the card catalogue of zoölogical literature, the plans for which have on several occasions been mentioned in this journal. The Bureau is located at Universitäts Str. 8, Zurich-Oberstrass, Switzerland, under the direction of Dr. H. H. Field and the control of an international committee nominated at the recent Congress of Zoölogy. The Bureau will print a prompt catalogue of all zoölogical papers, whether published separately, or as articles in scientific journals. For the first year a subscription rate has been chosen which would barely cover the cost of printing (not of compilation nor of sorting) on an estimate of 100 subscribers to the whole set of cards. If this number cannot be reached, then the Bureau will be obliged, not merely to pay for the work of sorting and sending, but must also advance money to pay the deficit on the printing. If, on the other hand, 200 subscribers for the whole series can be secured, the card catalogue division of the Bureau's work would probably be self supporting, and any further increase might be used towards improving the material or towards reducing the price. In no case, however, will any profit be realized on the operations of the Bureau.

The entire set of cards is offered for sale at the rate of $2 per 1,000 cards (not including transportation), and it is estimated that about 8,000 cards will be issued during the first year. Special groups of cards, systematic or morphological, may be subscribed for at increased rates.

The Card Catalogue constitutes a special edition of the *Bibliographia Zoologica*, itself a continuation of the bibliographical part of the *Zoologischer Anzeiger*. This latter journal forms the connecting link with the *Bibliotheca Zoologica* of Engelmann, Carus und Engelmann, and Taschenberg, constituting an unbroken bibliography from the earliest times down to the present day. By a most fortunate arrangement with the eminent director of the *Zoologischer Anzeiger*, Prof. Carus will remain editor-in-chief of the *Bibliographia Zoologica*.

The Bureau will begin issuing an Anatomical Catalogue, the *Bibliographia Anatomica*, early in 1896, and arrangements will also be made for physiology, provided these two first experiments meet with success. The Botanical Section of the A. A. A. S., impressed with the importance of founding a similar bureau for botany, appointed at its last session an influential committee to study the working of the Zoölogical Bureau and to make arrangements for the establishment of a federated Bureau for Botany. It is, moreover, almost certain that a similar step will be taken in Brussels for yet other sciences by a powerful organization founded under the patronage of the Belgian government. It is, therefore, not excessive optimism to predict that it may be possible to realize in 1900 the great project of the Royal Society of London.

GENERAL.

IN the December number of Entomological News, Mrs. Annie T. Slosson gives a list of insects and spiders captured on or near the summit of Mt. Washington, N. H. With two previous lists, already published, the number of species foots up to 830, all taken at or above 5,500 altitude. This number does not represent the total fauna of this interesting region, as a number of Coleoptera, collected there by Mr. F. C. Bowditch, are not included. At first sight it appears surprising that so many insects should be found at such an altitude. However, it appears that the list includes, besides those indigenous to the climate and found in Labrador and northward, many living throughout the New England States, and doubtless not breeding on the summit of the mountain. The peculiar position of the peak, isolated in the midst of a temperate climate and of small extent, must facilitate the frequent occurrence of almost any of the more active insects from the surrounding valleys. To this fact, as well as to Mrs. Slosson's industry in collecting, her success may be attributed.

HARRISON G. DYAR.

THE editorial board of the *Astrophysical Journal* has decided that the Roland scale of wave-lengths, the ten millionth of a millimeter as a unit in which wave-lengths shall be expressed, the kilometer as the unit to be used in measurements of motion in the line of sight, and the nomenclature proposed by Vogel and Huggins for the hydrogen series be adopted. It also favors printing maps of spectra with the red end on the right and tables of wave-lengths with the shorter wave-length at the top. These standards will be used in the *Astrophysical Journal*, and it is hoped that they will be generally adopted.

THE annual meeting of the New York Zoölogical Society was held on January 7th, and the following officers were re-elected: President, Andrew H. Green; First Vice-President, Charles E. Whitehead; Second Vice-President, J. Hampden Robb; Treasurer, L. V. F. Randolph; Secretary, Madison Grant. The committee on a site for the new zoölogical garden reported that D. G. Elliot, of the Field Columbian Museum; A. E. Brown, of the Philadelphia Zoölogical Garden, and Frank Baker, of the Washington Zolöogical Garden, had examined the eligible sites in the city parks and regarded most favorably Van Cortlandt Park. It is the intention of the society to establish a garden in which the animals will not be closely confined but placed as far as possible under natural conditions.

AT a meeting of the American Philosophical Society on October 3d, Frederick Fraley was re-elected President and E. Otis Kendall and J. P. Lesley were re-elected Vice-Presidents. William Pepper was elected one of the Vice-Presidents in place of the late W. S. W. Ruschenberger. The Secretaries elected are: George F. Barker, George H. Horn, Patterson DuBois and Persifor Frazer.

ARRANGEMENTS are being made for the annual reception and exhibition of the New York Academy of Sciences, which will be held at the American Museum of Natural History and probably early in March. Professor H. F. Osborn is chairman of the executive committee and seventeen sciences are represented on the committee of arrangements. It is hoped that the coöperation of institutions outside of the city of New York may be secured to a greater extent than hitherto in the exhibits.

WE have received a list of the prizes conferred by the Paris Academy of Sciences on December 23d. These are too numerous to give in detail in this journal, but it may be interesting to note that the number of prizes offered is as great as sixty-nine. Several of the prizes are of the value of 10,000 fr., and one, for a method of curing an epidemic disease, is 100,000 fr. This prize was not, however, awarded this year.

IT is stated in the daily papers that Dr. John S. Billings, director of the Department of Hygiene in the University of Pennsylvania, has been elected librarian of the Consolidated Libraries of New York, representing the Lennox Library, the Astor Library and the Tilden Bequest.

The Botanical Library and the Herbarium of Columbia College, will be placed in a building to be erected in the New York Botanic Garden, and in return the privileges of the garden will be accorded to students of the College.

Macmillan & Co. announce that they will begin in September next a 'Garden craft series,' the first volume of which will be *Plant Breeding* by Professor L. H. Bailey.

The *British Medical Journal* states that the question of founding a medical faculty in the University of Odessa, which had been long under discussion, has finally been decided in the affirmative. The municipality of Odessa has generously offered to double its grant for the new faculty, raising it from 250,000 to 500,000 roubles, that is, to over $250,000.

The opening article in *Appleton's Popular Science Monthly* for January is a description of the origin of the Smithsonian Institution by Dr. H. Carrington Bolton. The author describes Smithson's curious career, but scarcely attempts to assign his reason for making the United States his residuary legatee. The article reviews the formation and growth of the institution, and a second article will consider its present status and many activities.

The election of officers of the Binghampton (N. Y.) Academy of Science, held on the afternoon of January 4th, resulted as follows:

President, Prof. E. R. Whitney (re-elected).

Vice-President, Prof. Herbert J. Jones (re-elected).

Recording Secretary, Willard N. Clute (re-elected).

Corresponding Secretary, Burt E. Nelson.

Treasurer, Joseph K. Noyes.

A reception was tendered the members in the evening by the Young Women's Christian Association at their rooms in the Strong Building.

A new Russian journal, a *Review of Psychiatry, Neurology and Experimental Psychology,* edited by Dr. Bekhteret, will hereafter be published monthly.

The deaths are announced of Cavaliere Dr. Alfonso Ademello, sanitary director of the hospital of Grossetto, and known for his excavations at Grossetto and for his writings on the Maremma, of Dr. Sickenberger, professor of botany and chemistry in the medical high school in Cairo; of Dr. A. de Cerqueira Paito, professor of organical chemistry in Bahia, and of Dr. Paul Reis, professor of physics at Mainz.

UNIVERSITY AND EDUCATIONAL NEWS.

The new catalogue of Harvard University shows the total number of instructors to be 366 and the total number of students 3,600. The students are distributed as follows: 1,771, College; 340, Scientific School; 285, Graduate School; 41, Divinity School; 465, Law School; 531, Medical School; 102, Dental School; 55, Veterinary; 15, Bussey Institute. The number of students is 310 greater than last year as compared with a gain of 134 for that year.

After 1901 only college graduates will be admitted to the Harvard medical school. Johns Hopkins University is the only American University now making this requirement.

The departments of Physics and Mechanical Engineering at Brown University have been materially improved by the removal of the work shops that formerly occupied the basement of the Wilson Physical Laboratory to a building recently constructed for their reception. The new building has thirty-six hundred square feet of floor space, and is well equipped with all the machinery necessary for thorough courses of instruction in practical metal and wood working. Of the rooms thus rendered available in the physical laboratory two are to be fitted out for high temperature and pressure investigations, two for an electrical engineering laboratory, and one for a drawing room for the department of civil engineering.

The late Franklin Baldwin, of North Grafton, Mass., has made the following bequests to take effect on the death of his wife: Wellesley College, $50,000 to found a chair in mathematics in memory of his daughter, Katie Emma Baldwin; Smith College, Northampton, $12,000 for scholarships; The University of Vermont, $10,000 for scholarships; Dartmouth College, $6,000 for scholarships. The residue of the estate (some $20,000) is left to Clark University.

DR. C. A. STRONG, associate professor of psychology in the University of Chicago, has been elected lecturer on psychology in Columbia College.

PROF. L. S. LUTHER, of Trinity College, Hartford, has been elected president of Kenyon College, Gambier, Ohio. Professor Theodore Stirling, the professor of natural science, has been during the last four years acting president.

PROF. THEODORE VON DER GOLTZ has been appointed professor of agriculture in the University at Bonn in the place of Prof. Dunkelberg, who has retired.

DISCUSSION AND CORRESPONDENCE.

QUATERNIONS.

EDITOR OF SCIENCE: The circular letter of Dr. Molenbroek and Mr. Kimura published in the issue of your journal for October 18th appears to me to be a distinct improvement upon their preceding letter published in *Nature* for October 3d. In the former letter they assume that Hamilton's Quaternions is a much more perfect method than it really is, and they affirm that the newer forms of vector theory invented by physicists are founded on definitions which are established by Quaternions, and are systems of notation rather than logical developments of a mathematical idea. They also advise the "many who are prejudiced against the calculus of quaternions and maintain the opinion that it is hard to understand and that it contains a great deal which is useless in addition to things immediately applicable" to "approach the calculus with proper care and meekness in the assurance that they will ere long rejoice in having at their disposal an instrument of research mightier far than they had the slightest notion of so long as they were in the domain of cartesian mathematics."

In recent years I have published a series of papers on Space Analysis, the express object of which is to unify and harmonize the several vector methods with one another and with the ordinary analysis. I exclude neither the idea of a vector nor the idea of a quaternion, and I do not attempt to make Nature simpler than she really is by identifying ideas that are different though complementary to one another. I look upon vector-analysis not as an independent and rival plant, but as a development of the old tree of mathematical analysis.

The greatest impediments to the progress of the method of Quaternions are not prejudice and false opinion in those to whom it is presented, but rather imperfections, mistakes and errors in the method itself. Hamilton ought to be reverenced for what he did accomplish, but that ought not to blind us to what he did not accomplish. It is an error to identify, as Hamilton does, vectors with quadrantal quaternions. It is an error to confound, as Hamilton does, successive with simultaneous addition; for thereby he failed to discover the generalization for space of the Exponential Theorem and of Taylor's Theorem. It is a mistake to introduce, as Hamilton does, a new notation which has no relation to the established notation of trigonometry, or to adopt conventions which do not harmonize with the established conventions of analysis.

To the amended proposal for an 'International Association for promoting the study of Quaternions and allied systems of Mathematics' there is no room for objection; for it does not assume the perfection and finality of Hamilton's work, but rather invites to the development and study of vector-analysis in its broadest sense. It will, I hope, receive a favorable response from all who are interested in the development or the teaching of space analysis. It is inevitable that there should be diversity of notation and warm discussion of principles among the pioneers in this region, but inasmuch as all are zealous for the truth, the proposed association would accelerate the progress to definite decisions, and thereby smooth the way for the spread of this, the highest development of the art of algebra.

Messrs. Molenbroek and Kimura refer to the remarkable advance in Electrical theory. That advance has been due in large measure to the practical manner in which electricians have discussed the principles and definitions of their science, finally settling all definitions by an authorized Congress. Doubtless the proposed association would eventually accomplish an equal good in its line. Electricians are alive to the importance of this work also, and the indications are that they will have much influence in its settlement.

But since at the present time there are writers on space analysis who see nothing but vectors, and other writers who identify vectors with quadrantal quaternions, and since the principles commonly accepted by Quaternionists are not free from fundamental errors, it is evident that much time is still required for the discussion of principles before definite decisions about notation can be arrived at. The notation which is adopted must be built on an adequate analysis if it is to be lasting. And here the π muddle in the system of electric and magnetic units ought to act as a warning to make haste slowly.

The logical harmony and unification of the whole of mathematical analysis ought to be kept in view. The algebra of space ought to include the algebra of the plane as a special case, just as the algebra of the plane includes the algebra of the line. And as the algebra of space includes the spherical and higher forms of trigonometry, it ought to be made to harmonize as much as possible with the existing notations and conventions of trigonometrical analysis. When vector analysis is developed and presented so as not to contradict, but, on the contrary, to include the ordinary branches of analysis, we may expect to see many zealous cultivators, many fruitful applications, and, finally, its universal diffusion. Then there will be no need of arguments to prove its utility. May the movement initiated by Messrs. Molenbroek and Kimura hasten the realization of this happy result.

Alexander Macfarlane.

Lehigh University.

SCIENTIFIC LITERATURE.

De Saint Louis a Tripoli par le lac Tchad. Par le Lieutenant-Colonel P. L. Monteil. Paris, Alcan. 1895. Pp. x. and 463. Fifteen itinerary charts and one general map. Profusely illustrated by Riou.

This book may be considered as the fruit of the treaty between England and France which was entered into on August 5, 1890. The reason for the treaty was the necessity of fixing a boundary between the regions subject to their respective influences along an imaginary line drawn from Say on the Niger to Lake Tchad.

Monteil proposed to the French government to traverse this region, starting from St. Louis, in the French possessions on the west coast of Africa. His object was to obtain treaties with as many of the native potentates along the route as possible, and thereby fix the boundary as far as France was concerned.

He left St. Louis on October 9, 1890, with one white companion, Adjt. Badaire, and twelve natives, four of the latter deserting him quite promptly. For twenty-seven months from this time his experiences are given with considerable minuteness. He had the regulation 'ups and downs' which are the lot of the explorer everywhere, particularly in Africa. As far as Wagodogho he followed the itineraries of Binger and Crozat. Beyond this point everything was relatively unknown, except where light had been thrown upon various points along the line when his path crossed the track of his predecessors, Denham and Clapperton, Barth, Nachtigal and others.

His occupations were numerous, as he was at various times soldier, engineer, physician, botanist, astronomer, cartographer, pharmacist, trader, diplomat and magician. Photography did not prosper with him. His early attempts were crushed in Paris; where his plates going to one office and his letter of instructions to another, they were both opened separately with the consequent disastrous result to the negatives. A final blow was struck at this portion of his work when a native stole his camera, plates and all. One can imagine the 'joy and perplexity' of the average native while examining this piece of apparatus, as well as the feelings of the rightful owner under the circumstances.

The loss, however, is made good by the superb set of illustrations by Riou, which are one of the charms of the volume. The artist has so thoroughly caught the spirit of the author that, much as we regret the absence of the true copies of nature, we feel satisfied by the insight which the skillful sketches give us on the subject.

Another feature of the book which cannot be too highly praised is the series of itinerary maps, which are inserted in the text of each chapter which is devoted to the description of a portion of the journey.

The book may be divided for practical purposes into two parts—the descriptive and the generalizing portions. His descriptions of men and things, are pleasant reading, and show us a man, wide awake to the meaning of the scenes through which he passed. Space does not permit of a detailed account of these, though many are of great interest and value. Some of the character sketches are very well done. The chapters which are devoted to his generalizations are by all means the best part of his work. They are scattered through the book and bear upon many subjects; geology, botany, natural history and anthropology all come in for a share, and while we may not agree with his conclusions, particularly upon some ethical questions, we cannot but agree that his clear statements of facts and conditions are well worthy of close attention. Some of each of these parts of the work will be referred to in this review.

He was almost uniformly successful in his diplomatic relations with the native chiefs with whom he came in contact. Sometimes under the most trying circumstances he carried his point. His French temperament seems to have been under splendid control, as it only comes to the surface when the pressure of affairs is removed and he feels free to express himself. This is greatly to his credit, and much of what might be called 'good fortune' by some is undoubtedly to be attributed to this fact.

His first treaty was made at San on January 14, 1891. Shortly after this he meets Capt. Quiquanodon and Dr. Crozat at Kinian. They reinforce his party most opportunely with both men and animals. On March 1 he reached Diasa. Here he received his last letters from France, bearing date of December 18, 1890. From this time until he reached Beni-Oulid, on December 6, 1892, he was virtually lost as far as hearing from the outside world was concerned.

An interesting description is given of Bobo-Dioulasso, where the houses are built upon high platforms, where 's'habiller est avoir quelque difformité à cacher,' and where the children are carried under a 'carapace' of rods. At Souro he has his first real encounter with fetichism, and a good idea is given of its wide ramifications and its effects upon the life and habits of the natives, as well as the consequences which hang over the innocent traveler's head who ignorantly invades the 'sacred limits' which are spread around him like so many snares.

His account of the 'whistle system' of telegraphy, as employed in the Bobo country (p. 107), is curious reading. Imagine the swarthy native taking a siesta at sunset, and carrying on a conversation by this means—arranging for a hunting party in the morning; conducting some piece of business; lovers intoning their pure love ditties; enemies challenging one another, etc., etc., for of such is the 400 of Bobo.

The Mossi country is described on pp. 121 *et seq.* This region on the bend of the Niger, is occupied by a well organized people whose traditions carry them back to the beginning of the world, without exactly fixing the date of this event. Naba, the first of the race, had 333 sons, and divided his kingdom among them at his death. Wagodogho is the seat of the main head of the whole kingdom, and the Naba of this place is the Naba of the Nabas. He wears as an emblem of his proud preëminence, a special head dress which is a species of three decked turban; but this with his very numerous harem, seems to be the limit of his prerogatives.

He reached Wagodogho on April 28, only to be ordered out of town. Protests that he was the envoy of the *king* of France were of no avail. Eventually, a music box, a Persian saddle and a sword, did the business for him, and he was received as a man and brother. He reached Dori on May 22d, and it was high time that he did so, for this was one of the very low points in his curvilinear career. Things were at a very low ebb with him at this point.

While resting at Dori, on what might be called the boarder line between the civilized and the uncivilized nations of central Africa, he gives us a sketch of the relations of Mohammedanism to progress in this part of the world. It seems strange to find him favoring polygamy and slavery, and expressing the opinion that the religion of Islam is so adjusted to the conditions of the country that if peaceful means had been used for its propagation, instead of force, it might not be too much to say that all Africa would now be under the sway of the Moslem faith. The bearings of the two systems of fetichism and Mohammedanism upon the peace of mind of the traveller are portrayed in a most telling manner.

The trip to Say, on the Niger, was accomplished in eight months. Just before reaching Ouro-Gueladjio he passed through one of his darkest periods, some of the journey being made on foot, his animals having been reduced by desertions and death from twenty-five to two, and his men from forty-seven to seventeen.

The question of the Saharan Sea is discussed, on page 199 and the following pages, as viewed from a structural standpoint, with reference to the large basins known as the Dalhols. The trend of these supposed branches of the extinct sea, as well as the existence of the flabelliform Egyptian palm in this exceptional locality, seem to favor the arguments advanced in the text.

Just beyond this point in the book, where he deals with the regions about Argoungou and Sokoto, we pass through one of his brighter periods. With great good fortune he happened to pass through this part of the country during a lull in the proceedings—generally in a disturbed state among these races. A few months later, he would have had a hard time indeed, even if he had escaped with his life from the political 'cloud burst' which took place over the whole of this region. His state of mind is well illustrated by the pretty sentence on page 238, upon the moral effect of sunshine. This also probably accounts for the rather rose-colered description of the Peuls which immediately follows.

In chapter X. (p. 269) there are some good character studies in the course of the account of his stay at Kano. The 'clearing house system' in use among these people is curious enough to be amusing. Articles of fixed value are traded for one another directly, but when *small change* is involved the *trader draws on his bank*. This consists in a mule load of cowrie shells, 50,000 of them composing a load and representing a total value of $10.

Kano is further the center of the cola nut trade. This article, which of recent years has been introduced into the medical pharmacopœia, is treated of in numerous aspects. The nut is found in a belt lying between 6° 30′ and 11° or 12° North Latitude; and though it may be the 'Coffee of the Soudan' and correspond in all its virtues to the betel nut in India, opium in China, the cigarette of a Spaniard, or the dog of a blind man, it can hardly be accepted as a sort of universal panacea.

At this point we come across the discussion of another phase of the slavery question, viz.: the captives of war. They are captives in name, but slaves in reality, and our author speaks of the amenities of their existence. Their masters are forced to be easy with them, for the reason that some day, through changed fortunes of war, they may in turn occupy the same position. And again, the number of these captives is so great, as contrasted with the number of the freemen, that an insurrection might change the order of things. Such occurrences are not unknown in the political or domestic life of this untamed Eden. The captive is usually held by his captor for a few months, until some mart is reached where he can be disposed of, if he survives the harsh treatment of the march thither. Then, if he is intelligent, he is pushed forward rapidly and can attain to high positions. He is provided with a wife, and his lot becomes settled if he has a family, as neither he nor they can be sold. It is often a matter of good fortune into whose hands he falls. In some instances we read of the 'Captives of the Crown, as being placed in charged of great undertakings and expeditions of all sorts in the Soudan. Hence, at least, so we are told, 'the captive is a social and economic necessity in the Soudan.'

From Kano he sends a courier to Tripoli in the month of January, 1892, and proceeds onward to Kukawa on Lake Tchad, which point was reached on April 10th. His description of the stay at this place, which covered some three and a-half months while he awaited the formation of a caravan to proceed northward, contains many bits of information of value. Here he was subjected to the infamous practice, in the way of the extortion of gifts, which was the means of almost ruining Barth and Nachtigal. Both of these travellers were stranded in this region by similar delays, and their life blood extracted by the polite but very costly exchange of 'gifts.' Monteil had learned a lesson from their experience, and, secreting sufficient means to carry him through, 'played poor.' The consequences were evident in the great privations to which he was subjected for some time after this. At length his opportunity arrives, a caravan is ready to leave. He makes the sheik a series of presents as farewell gifts, which greatly embarrass that individual to properly and adequately return, which was his immediate duty. The tide was turned in his favor, and he got everything he wanted, and thus escaped this new species of danger with safety.

He speaks very caustically of the rotten and shaky condition of the affairs of Bornu, of which state Kukawa is the chief city. It took only a few months for his prediction of the fall of this empire to be verified.

On August 15, a year after leaving the Niger, he starts on the journey to Tripoli. The caravan of 78 camels, 7 horses, *30 men* and *30 slaves* must have presented a fine appearance, and their minds must have been much lighter as they started upon the last stage of their trip. Aside from the discussion of the usual tribulations of the long journey over the Sahara, and a rather pathetic description of the evil works of the 'demons of the desert who lead travelers astray,' nothing novel is given in this part of the book.

On December 10, 1892, he reached Tripoli, where his troubles were over. He was welcomed in France in the most cordial and well-deserved manner. His promotion, his medals and other honors have certainly been well earned, and they grace a hard-working, earnest and modest man. The volume contains much more valuable material than is usually found in a book of travels, particularly when written by one who is rather more of a military man and diplomat than a scientist. W. L.

A Laboratory Course in Experimental Physics: By W. J. LOUDON and J. C. McLENNAN. Macmillan & Co. 8vo., 300 pp. Price, $1.90.

This book is written by the Demonstrater and the Assistant Demonstrater in Physics in the University of Toronto, and it is evidently designed to meet the special requirements of students in that institution. It is divided into two parts, constituting an elementary course and an advanced course. Part I includes a brief treatment of length-measuring instruments, vernier, cathetometer, spherometer, etc., which is followed by some exercises in density determinations, experiments with pressure and volume of gases and a little about capillarity. The remainder of the elementary course is mostly given to geometrical optics, although there is something of a treatment of photometry and a few exercises in specific and latent heat. The second part treats of acoustics, heat, electricity and magnetism, with a short appendix on gravity and the pendulum. An elementary knowledge of dynamics and the calculus is assumed in the advanced course. In the various experiments described it is generally assumed that a perfectly adjusted piece of apparatus is at hand ready to be set going. The instruments figured and described in the 'acoustics' are from the *atelier* of Rudolph Koenig, and nearly all of the illustrations in the book appear to have been made from perfectly constructed and finished apparatus. It is generally admitted that a large part of the value of the training in a physical laboratory comes from experience in designing, constructing and adjusting apparatus for definite purposes. In no other way can a student so quickly and thoroughly learn the sources of error entering into an experiment, or the methods of eliminating them and in a general way become familiar with the limits of accuracy to which he is restricted. Viewed from this standpoint, such a system as seems to be implied in this book is not to be commended. In fact, it is a little difficult to know under what conditions this book is intended to be used. The authors say in the preface that it owes its origin to the 'difficulty experienced in providing, during a limited time, ample instruction in the matter of details and methods' * * * 'at the present day, when students are required to gain knowledge of natural phenomena by performing experiments for themselves in laboratories.' Although not quite definite, this seems to imply that students are expected to acquire such knowledge of physics as they get, by the use of this book, and many pages of the text appear to strengthen this view. A decade or more ago it was quite a popular notion that the way to treat physics was to begin, especially if the learners were young children, with laboratory exercises. The student was to find everything out for himself, and all the great truths of physical science were to be rediscovered every day in the secondary schools. No greater farce than this was ever enacted, for it was *seriously* approved and attempted by many of the great masters of pedagogy. It has now joined the host of other abandoned theories, at least as far as those who really teach physics are concerned, and it cannot be assumed that it still survives, or indeed, that it ever existed at the well-known institution from which this book came. It must be, therefore, that the volume is intended to be used as a guide in laboratory practice which supplements text-book and lecture instruction. From this standpoint the text contains much that might well be omitted, for it must almost necessarily have been included in the text-book or lecture work; and, although the plan may, and doubtless does, suit the scheme of instruction and available facilities in the institution in which it was prepared, a wider constituency could be served by assuming fewer perfectly made instruments and throwing the student on his own resources to a greater extent, in the matter of adjusting, designing and assembling the apparatus he is to use.

The Intellectual Rise in Electricity. By PARK BENJAMIN. D. Appleton & Company. 8°. Pp. 600.

In the preparation and publication of this volume Mr. Benjamin has done a work for which all interested in physical science, and especially in electricity, will thank him. In these days few men capable of properly recording the progress of scientific discovery possess, at the same time, the instinct of the historian to a degree necessary for the making of a book like this. Few will deny that a knowledge of the history of a discovery, the circumstances and conditions under which it was made, and particularly the personality of the discoverer, add enormously to the interest of the fact itself and, besides, has its practical value in serving to fix the fact more definitely and more lastingly in one's memory. In the preparation of text-books the historical and biographical inclinations are usually either entirely suppressed or held severely in check and the student who depends on them alone, finds only the cold facts, presented in their logical or scientific sequence and stripped entirely of the charm of personal and chronological relationship. The wise instructor makes up for this deficiency and to him Mr. Benjamin's work will be doubly welcome. In making it an enormous amount of labor has been expended in the consultation of original sources of information, of many ages and many tongues. It is practically a history of electricity and magnetism from the earliest traditions to the end of the last century. But the history of one branch of science is like the history of one nation or one race; it cannot be written alone, and this book of necessity involves a study of the development of all physical science. When one recalls the names that appear, Thales, Aristotle, Archimedes, Roger Bacon, Peregrinus, Porta, Cardan, Gilbert, Galileo, von Guericke, Boyle, Hooke, Newton, Halley, Gray, Nollet, Franklin, together with many others, it becomes clear that in telling their lives one must tell the history of natural philosophy, and the history of natural philosophy is largely a history of the intellectual development of the world. This doubtless suggested to the author the peculiar and rather unfortunate title which he has fixed upon his work. The account begins with a chapter on the earliest traditions relating to the 'amber phenomenon' and to the lodestone, which have always been considered as in some degree related to each other, and a knowledge of which may have existed among prehistoric people. What was known among the Chinese, early Egyptians and Greeks is discussed and the subject is followed in its emergence from the periods of myth and legend or tradition to that of real and fairly authentic history. The discoveries of Columbus are discussed and two excellent chapters are devoted to the work of Gilbert, the real father of the science. The relations of Francis Bacon and Gilbert are gone into with considerable detail and a number of important facts brought out which will probably be new to most physicists, who are not likely to have made a critical study of the origin and sources of Bacon's philosophy. Many of them will doubtless feel inclined to rocommend to those admirers of the great chancellor who are trying to prove that he wrote the plays of Shakespeare the desirability of diverting their energies into an investigation of the authorship of the *Novum Organum.*

There is a good account of the founding of the Royal Society of London and of the electrical and magnetic work of Boyle, Newton and Halley.

The concluding chapter is devoted to a presentation of the discoveries of Benjamin Franklin, in which, of course, will be found references to many other contemporaneous electricians.

The work is distinctly a history. No technical preparation is required to read it and it is free from all mathematical or other discussions which might involve difficulty. The style is in the main excellent, but marred occasionally by excessive exuberance and diffuseness. An example of this is found in the several pages devoted to the story of Franklin's kite experiment, a very small part of which reads as follows:

"Quietly Franklin is arranging the silk ribbon and the key. This done he watches the cord close to him. There is no sign yet to guide him. Has he failed? Suddenly he sees the little loose fibres of the twine erect themselves. He has not failed, but the moment has come. Without a tremor he advances his knuckles to the key. And then a little crack, a little spark—the same little crack and the same little spark which he had taken a hundred times from his glass tube—and the great discovery is complete, his name immortal."

As a matter of fact, this kite experiment was quite unnecessary to establish Franklin's claim, which had before been put to the test in France, and Franklin's fame would have been quite as great without it, although unquestionably less picturesque. The experiment was interesting and not without dramatic quality, but, on the whole, a description of it in Franklin's own words would have been more satisfactory.

An Introduction to the Study of Zoölogy. By B. LINDSAY, C. S., of Girton Coll., Cambridge. London, Swan, Sonnenschein & Co. New York, Macmillan & Co. 1895. Pp. xix+356, with 124 illustrations and diagrams. $1.60.

This little volume forms one of the series of 'Introductory Science Text-books,' and is designed, as the author states in the preface, to serve as 'a kind of guide book for readers who are about to begin the study of zoölogy.'

The plan of the book embraces a Glossary, General Principles of Zoölogy (Part I.), Systematic Zoölogy (Part II.), Advice to Students (Part III.), and an index of subjects and of names of genera.

Part I. treats of the distinction between animals and plants, the cell, origin of species, embryology, etc., much in the style of Claus and Sedgwick's 'Text-book of Zoölogy,' whose work apparently forms a basis for this. To the general reader this part will doubtless prove interesting, as it discusses in an attractive manner the biological principles involved in an intelligent study of the animal kingdom, and explains the meaning of many of the terms and phrases so often used but as often not understood. The criticism might, however, be made that the space (114 pages) given to this division of the subject is too large in proportion to that devoted to the systematic portion of the work (190 pages).

In Part II. we have a chapter discussing the principles of classification and, as examples of classification by type, brief descriptions of Amœba, Vorticella, Hydra and the earth-worm. Then follow nine chapters each devoted to one of the Phyla of the animal kingdom; a table of classification with examples of its use closes this part. The concluding part has chapters on 'The Use of Books' and 'Practical Work;' in these the student is referred to some of the standard zoölogical works, and useful hints are given to those who would learn to see and think for themselves.

The design of the book is certainly a good one. Many readers of popular works on animals and their habits, would be glad to learn something more of the relation that these animals bear to others, and of the zoölogical principles as understood at the present day. To consult a zoölogy full of technical terms and anatomical figures is not usually attractive to the beginner. Given a book that is clear, concise and correct, but not too technical, such a reader would be led further in the same direction and, what is very important, would not have to unlearn.

The question naturally arises, does this book carry out the design? The author has in the main succeeded in writing a very readable book marked by a pleasant and interesting style; yet there are a few places where, through a faulty mode of expression, the meaning is rendered obscure, *e. g.* "Animals develop to a higher point, in which the body layers develop complicated organs, usually go through a larval stage very different in appearance from the adult" (p. 74). Other obscure sentences refer to the germ layers (p. 30), and the openings of the thoracic duct (p. 45).

In the compilation of a brief introductory text-book we can hardly expect to find the pages entirely free from errors; and, while in the main, the author presents a correct statement of our zoölogical knowledge, several errors have found their way into the book. For example, bone is said to be found in the cuttlefish (p. 43), though we find on p. 228 cartilage correctly given. The paranucleus of the Ciliata is confused with the nucleolus (p. 138). On p. 180 the Dendrocœla are stated on one line to be mostly fresh-water forms and a few lines further down to be mostly marine. A similar contradiction appears on p. 186, where we read 'The Entomostraca * * * are mostly fresh-water forms,' while, of the examples given, all are marine. On p. 198 there are two errors: the Chilognatha have 'two pairs of legs on each segment,' and of the thorax and abdomen of insects, it is stated that 'both have the segments completely fused.'

What seems a serious fault in the plan of the systematic part is the defining a group or Phylum by means of types, which are themselves not sufficiently described. Chapter IV. will illustrate this: The Echinoderms are defined as 'animals more or less resembling in structure the sea-urchin.' One who had never seen a sea-urchin would naturally expect to find a figure with which to compare the other forms of the Phylum; but there is none given, and the brief description would hardly serve his purpose. Had there been an anatomical figure and a more detailed description of each of the types selected, the book would be more useful to the ordinary reader.

The chapter on the Cœlenterata is perhaps the most unsatisfactory. The difficult group of the Cnidaria is best understood by treating the simpler Hydrozoa first and then the Scyphozoa; instead we have the arrangement as given by Claus and Sedgwick, and there is, as well, a lack of clearness and definite system. We think the book would have been improved by giving more attention to the Vertebrates. The description of the mammals is mostly confined to a discussion of the teeth, which subject, important as these organs are, is not likely to attract the reader or satisfy him in lieu of some other details which would naturally occur to him in comparing the various orders of mammals.

Notwithstanding the criticism of these, and certain other errors which should be corrected, we believe that the book will prove of value to the reader and, in the hands of a teacher who can amplify and explain, would serve as a good text-book where principles, rather than a detailed learning of systems and names, are desired.

The book is attractively and clearly printed. The text is quite free from typographical errors; we notice only 'infusoriæ' (p. 67), 'Arthropoids' (p. 186), 'fore' for four (p. 267). The numerous cross references are correctly given except that 'fig. 12' should be fig. 121 (p. 299). The 'List of Illustrations' shows, however, careless proof reading, for no less than nine of the figures are referred to the wrong page. In the contents there are two more errors, and we presume that of the original figures No. 133 should be No. 123.

W. M. RANKIN.

SCIENTIFIC JOURNALS.

THE AMERICAN GEOLOGIST, JANUARY.

DR. C. E. BEECHER presents a sketch of James Dwight Dana, in which attention is called to the varied faculties and broad scientific knowledge of the man, but no attempt is made to give a complete account of his life. Special note is made of his ability to carefully weigh scientific evidence and of his unprejudiced position and final decision concerning the doctrine of evolution. A portrait and a bibliography accompany the sketch.

Mr. Warren Upham, in an article on 'Physical Conditions of the Flow of Glaciers,' describes the veined or ribboned structure and the granular structure of glaciers and ice sheets, with a review of the theories of Forbes and Tyndall to account for glacial motion. Preference is given to the recent granulation theory of Deeley and Fletcher; and the lamination of the Greenland and Antarctic ice sheets is attributed, like that of Alpine glaciers, to the differential shearing movement of the ice layers, with varying decrease, growth and shear of contiguous ice granules.

Some phenomena presented by floating sand are discussed by Prof. F. W. Simonds. He records an instance of the floating of a considerable amount of sand on the Llano River of Texas, and he also states the results obtained by artifically floating sand of various materials and degrees of fineness.

Mr. Oscar H. Hershey describes the ancient river deposits of the Spring River valley in Kansas and outlines the Quaternary history of this stream.

Prof. E. W. Claypole, in an article entitled 'The Timepiece of Geology,' rapidly sketches the rise of paleontology and the use of fossils in determining the age of strata. The application of this means of fixing the age of various rocks is rapid and easy, but the final test is stratigraphy.

In an editorial comment Mr. Upham notices the shell-bearing sand and clay beds between deposits of till at Clava, Scotland. The interglacial fossiliferous beds he thinks to be modified drift, like the similarly shell-bearing sand and gravel of Cape Cod. In neither case would he consider the enclosed marine fossils to be evidence of submergence, instead of which the shells and their fragments are referred to glacial erosion from old sea beds and transportation in the ice sheets to altitudes where they are now found.

Under 'Correspondence' Prof. W. B. Scott writes concerning the term 'Goodnight Beds,' proposed for a division of the Texas Tertiary by Mr. W. F. Cummins.

PSYCHE, JANUARY.

A. P. MORSE begins a review of the N. E. Tryxalinæ, giving tables for the determination of the 8 genera and 15 species; three of the genera are new. H. G. Dyar describes and discusses an arctic Lymantriid larva found on Mt. Washington, N. H., which he suspects is Dasychira rossii. C. H. Tyler Townsend gives a table for the determination of the 12 species of Exorista from temperate North America known to him, describing one of them as new; and F. H. Harvey gives some notes on Smerinthus cerysii with a description of some of the early stages.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

A SPECIAL meeting was held December 26th in the assembly hall of the Cosmos Club under the auspices of the joint commission of the scientific societies of Washington, on the occasion of the annual address of the retiring President, Mr. Wm. H. Ashmead. Major J. W. Powell, of the joint commission, presided. Mr. Ashmead's subject was 'The Phylogeny of the Hymenoptera,' which he treated at length, giving his ideas as to the position of the Hymenoptera in the class Insecta, and as to the relative position of the several families of the order.

The 113th regular meeting was held January 2d. The following officers were elected for the year 1896: President, C. L. Marlatt; Vice-Presidents, Theodore Gill and H. G. Hubbard; Recording Secretary, L. O. Howard; Corresponding Secretary, Frank Benton; Treasurer, E. A. Schwarz; Additional Members Executive Committee, W. H. Ashmead, D. W. Coquillett and C. W. Stiles.

Mr. Schwarz presented a paper on the semi-tropical insect fauna of Texas. He referred to the fact that he had made a short visit to the region in question in 1895, and said that the fauna west and south of the Guadaloupe River, and which extends across the Rio Grande into the Mexican States of Coahuila and Tamaulipas, is by no means semi-tropical in its character. It is simply a subdivision of the lower Sonoran fauna. The real semi-tropical in Texas occupies an extremely small area, namely, the delta of the Rio Grande from the mouth of the river to the head of the Arroyo Colorado. The latter is an ancient bed of the Rio Grande, and forms the northern boundary of the semi-tropical fauna. Within this area the fauna in question occurs in narrow isolated strips, within the bends of the river, along the various resacas which intersect and meander through this region. The more elevated land separating these strips is occupied by the general fauna of southwestern Texas, but there is a maritime fauna of a more tropical character extending along the coast, probably as far north as Corpus Christi Bay. Finally the fauna of the yucca-covered ridges running parallel with the coast also belong to the semi-tropical region.

Dr. Gill said that Mr. Schwarz's observations on the extremely limited character of this fauna in Texas agree with his own deductions from the study of fishes. The paper was further discussed by Messrs. Ashmead and Howard.

Mr. Ashmead presented a paper on the genera of the Eupelminæ, showing that ten years ago only eight genera were tabulated by Cresson, and only one of these was known to occur in the United States. As a result of recent studies he has found in the United States representatives of 25 genera, several of which are new. He spoke briefly of some of the peculiar forms.

A paper by Mr. C. F. Baker on 'The Affinities of Neolarra,' was read by the Secretary. The writer concluded that this genus does not belong to the Bembecidæ, with which it had been placed by Ashmead, but to the Apidæ. The paper was discussed by Mr. Ashmead, who said that he agreed with Mr. Baker in his conclusions. The speaker in his original description of Neolarra had been led to place it with the Bembecidæ, largely from the fact that the type was in such poor condition that some of its important characters could not be well understood. He further said that he agreed with Haliday in considering the Bembecidæ as rather closely related to the bees on account of the structure of the mouthparts.

L. O. Howard,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

At the last meeting of the Philosophical Society of Washington the following communications were presented:

1. By Lieutenant W. H. Beehler, United States Navy, on 'The compensation of vibrations and other motions of a vessel at sea for the constant level-base of the Solarometer.' Illustrated by diagrams and a solarometer instrument itself.

2. By E. D. Preston, on 'Some original methods of reducing stars from mean to apparent place.' Illustrated by diagrams showing how results are quickly obtained graphically.

Berard R. Green,
Secretary.

NEW BOOKS.

The Sun. C. A. Young. New and Revised Edition. New York, D. Appleton & Co. 1895. Pp. xii+363. $2.00.

Introduction to the Study of Fungi. M. C. Cooke. London, Adam and Charles Black. New York, Macmillan & Co. 1895. Pp. x+360.

Mechanics and Hydrostatics. R. T. Glazebrook. Cambridge, University Press. New York, Macmillan & Co. 1895. Pp. xiv+208+xxiv. $2.25.

Primer of the History of Mathematics. W. W. Rouse Ball. London and New York, Macmillan & Co. 1895. Pp. iv+158. 65 cts.

Plane and Solid Geometry. Wooster Woodruff Beman and David Eugene Smith. Boston and London, Ginn & Co. 1895. Pp. ix+320. $1.35.

The Theory of Social Forces: Simon N. Patton. Philadelphia, American Academy of Political and Social Science. 1896. Pp. 151.

Ethnology. A. H. Keane. Cambridge, University Press. New York, Macmillan & Co. 1896. Pp. xxx+442. $2.60.

Principles of Metallurgy. Arthur H. Hiorns. London and New York, Macmillan & Co. 1895. Pp. xiv+388.

The Chemists' Compendium. C. J. S. Thompson. London, Whittaker & Co. New York, Macmillan & Co. 1896. Pp. 230. $1.00.

Practical Inorganic Chemistry. G. S. Turpin. London and New York, Macmillan & Co. 1895. Pp. vii+156. 60 cents.

SCIENCE

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE eighth annual meeting of the American Physiological Society was held in Philadelphia on December 27th and 28th, 1895. The meeting was preceded by the usual smoke talk upon the evening of December 26th. Three of the four formal sessions of the Society were held at the University of Pennsylvania, the fourth in the physiological laboratory of the Jefferson Medical College.

The following communications were presented and discussed:

1. R. H. CHITTENDEN: *The mucin of the white fibrous connective tissue.*

The mucin was prepared from ox-tendons by various methods, more or less analogous to those employed by Loebisch, but the products were all characterized by a comparatively high content of sulphur (2.30 per cent.), whereas tendon-mucin has heretofore been considered as having a low content of this element (0.81 per cent). The various results attained point to the probability that white fibrous tissue contains two or more mucins, closely related in general properties and reactions, but dissimilar in composition, owing possibly to variations in the proportion of proteid and carbohydrate radicles entering into the compound. In the several products analyzed, however, the percentage of sulphur was constant, the variability being confined to the carbon and nitrogen.

Especially important were the results obtained on cleavage of the mucin with boiling dilute acid (HCl). The presence of a true carbohydrate group was plainly shown by obtaining a well defined and crystalline osazone by the phenylhydrazine test. The osazone so obtained crystallizes in fine yellow needles usually arranged in rosettes. When purified as much as possible the osazone is readily soluble in warm water, alcohol, ether, chloroform and benzol. It melts at 158°–160°C., and appears to resemble very closely the pentaglucosazone obtained by Hammarsten from the cleavage product of the peculiar gluconucleoproteid described by him as present in the pancreas.

2. A. R. Cushny: *The distribution of iron in the Invertebrates.*

While the accumulation of iron in the Vertebrates is generally supposed to be a provision for supplying iron to the blood, such an explanation will not hold for the large percentage of iron in the hepato-pancreas of the Invertebrates, since in the latter the blood contains only traces of iron. The hepato-pancreas of the Crustacea and the Echinodermata shows about the same proportion of iron as the Mammalian liver, while the Mollusca have a much larger accumulation than either. Muscle seems to contain about the same percentage of iron throughout the animal kingdom, and in organisms without hepatic tissues, such as the Actinia, the percentage seems to approximate that of muscle.

3. J. J. Abel: *A preliminary account of the chemical properties of the pigment of the negro's skin.* (With W. S. Davis.)

This pigment is of importance, not alone because it is a distinguishing characteristic of the great majority of the human race and because it may be found to serve a physiological purpose, but also because of its very probable relationship to the pigment more sparingly deposited in the skin of the so-called white races and to that found in the hair.

It may also be found related to the pigment of the skin in certain pathological conditions, as in the bronzed skin of Addison's disease, or in the brown or black patches known as *naevi spili.*

The authors have succeeded in isolating the coloring principle of the negro's skin and they hope to apply their method to other instances of skin pigmentation. The isolated pigment has not yet been obtained entirely free of mineral constituents. After incineration the resulting ash consists mainly of silicon dioxide; a very little iron, amounting to 0.1% or less of the original weight of substance, is also present.

At present the authors are attempting to determine the composition of the pigment granules, the minute anatomical elements found in the lower epidermal cells which contain the pigment in union with other substances. While as yet unprepared to give quantitative results, they are convinced that these black granules contain very much inorganic matter, iron being present in considerable amount.

The isolated pigment is found to be very resistant toward destructive chemical agents. Freshly precipitated it is soluble in water, in alcohol (90%) and in mixtures of alcohol and ether. In its behavior toward mineral acids, alkalis and the agents employed to precipitate proteids and also toward oxidizing agents, it agrees with the dark pigments that have been obtained from the hair, from the choroid coat of the eye and from melanotic tumors; in short, it must be grouped with that ill-defined class of compounds known as melanins.

The pigment contained in the hair of the negro was also isolated and was found to respond in a like manner to the many chemical tests to which it was subjected. Ultimate analyses of the skin and the hair pigments also showed a close agreement.

Since the recorded analyses of the pigment of the dark hair of the white races show many points in common with those of the negro's skin and hair, it would seem very probable that the pigment of the negro's skin is closely related to that found in the hair of the white races.

The percentages of carbon, hydrogen, nitrogen, sulphur and oxygen found in the isolated pigment are far from supporting the theory that it is derived from the coloring principle of the blood.

Dry distillation of the pigment carried on at a certain temperature yields much pyrrol, a fact of special interest, since pyrrol has also been obtained from derivatives of chlorophyll and hæmoglobin and from certain melanins and proteids. While we are not justified at present in classifying the various pigments referred to as pyrrol derivatives, the presence of this chemical among their decomposition products would suggest a closer chemical union between chlorophyll and some of the animal pigments named than has hitherto been thought to exist.

4. T. B. ALDRICH: *On the chemical and physiological properties of the fluid secreted by the anal glands of Mephitis mephitica.*

The secretion, at least when examined a few hours after removal from the sacs, has a neutral reaction, a specific gravity, at ordinary temperatures, less than water, a golden yellow color, and a very well-known characteristic and penetrating odor. It burns with a luminous flame, giving off sulphur dioxide fumes, and gives all of the mercaptan and some of the alkylsulphide reactions.

By distillation the secretion is separated into two sharply defined, nearly equal portions: *A*, boiling between 100° and 130° C., and having the odor of the secretion; *B*, boiling over 130° C., and having a less offensive odor than *A*. *A* gives all the mercaptan and some of the alkylsulphide reactions; *B* does not react with either lead acetate or mercuric oxide, but gives some of the alkylsulphide reactions. In *A* we have one or more of the higher mercaptans, in *B* we have probably some alkylsulphides.

The fractional distillation of *A* gave three portions: *C*, B. P. 100–110° C.; *D*, B. P. 110–120° C., and *E*, B. P. over 120° C. *C* constitutes about one-half of *A*; the three fractions gave all the mercaptan reactions.

For the purpose of identifying the mercaptans in fraction *C*, several sulphur determinations were made; the lead and mercury compounds were made and subjected also to analysis. These analyses gave results which point to the presence of one of the butylmercaptans.

It is found that one is able to recognize with the nose $\frac{1}{690000000}$ mg of *C*; showing that it is this part of the original secretion which gives it its great penetrating and diffusing property.

The secretion is a powerful anæsthetic. There is an instance on record illustrating this property. Some years ago a number of boys caused one of their companions to inhale an unknown quantity of the secretion. The victim lost consciousness, but recovered under the care of a physician and showed no after-effects. The fluid also has the properties of a local irritant, *e. g.*, a drop in the eye setting up a conjunctivitis. Those that have worked with the secretion and have inhaled much of the vapor complain of violent headaches and dysuria. The present writer has not observed these symptoms in himself, although he has worked with comparatively large quantities of the secretion for a long time.

Further chemical and physiological experiments are now in progress.

5. G. LUSK: *Phloridzin diabetes and the maximum of sugar from proteid.*

It was shown that after administration

to fasting rabbits of small doses (1-2 grms.) of phloridzin at frequent intervals (8-12 hours) sugar appeared in large quantity in the urine of the first twenty-four hours, representing a proportion of dextrose to nitrogen in the urine as high as 5.4 is to 1, or D: N:: 5.4:1. In the urine of the second twenty-four hours the relation, however, approximated that found by Minkowski in fasting dogs after extirpation of the pancreas *i. e.*, D:N:: 2.8:1. The action of phloridzin in fasting rabbits is to sweep the organization free from sugar, and thereafter to remove such sugar as may be formed from proteid. Calculation shows that the 45.08 grms. of dextrose produced from the oxidation of 100 grms. of proteid in tissue metabolism contain 44.4% of the available energy in the proteid (using Rübner's estimate that 1 grm. of proteid yields 4000 Cal. in the body.)

6. W. T. PORTER: *Further researches on the coronary arteries.*

The frequency with which arrest follows closure of one of the large coronary branches depends on the size of the artery ligated and on the irritability of the heart at the time the ligation is made. The consequences of closing a sufficiently large branch are a fall of the intracardiac pressure during systole, a rise during diastole, a fall in the quantity of blood discharged from the left ventricle, and finally arrest with fibrillary contractions. These consequences are not the result of the mechanical injury done the heart in the operation of ligation. Severe crushing of the cardiac tissue near the coronary arteries rarely produces the phenomena in question. Nor were they once seen in nearly one hundred preparations of the arteries for ligation. Further, the phenomena described can all be produced by closure of the coronary arteries without mechanical injury. This may be accomplished by plugging the mouth of the left coronary artery with a glass rod passed into the aorta through the subclavian or innominate arteries. It can also be done by closing the arch of the aorta for a few seconds, injecting into the aorta at the same time a quantity of lycopodium mixed with defibrinated blood. The lycopodium enters the coronary arteries and closes their smaller branches by embolism. The changes in intracardiac pressure and the arrest with fibrillary contractions are therefore not due to mechanical injury of the heart. They must then be a consequence of the sudden anæmia of the heart muscle caused by closing the arteries that supply it. There is no fundamental difference between the uncoördinated contractions seen in the heart after its arrest from hemmorrhage, as after opening the large arteries, and the fibrillary contractions brought on by closure of a coronary artery.

7. G. N. STEWART: *Note on the quantity of blood in the lesser circulation.*

8. C. F. HODGE: *Histological characters of lymph as distinguished from protoplasm.*

The ordinary histological analysis of an organ includes the cells characteristic of it, the connective tissue supporting structures, its blood vessels and lymphatics, and its nervous supply. In addition to the above, lymph is continually streaming through the cells and between them. We know that this lymph contains large quantities of proteid matter in solution which is precipitated by the ordinary reagents used in hardening tissues for microscopical purposes. If this precipitate is wholly inert toward staining reagents, we are not even then justified in leaving it out of our histological analysis, since many structures of the greatest importance are 'achromatic.' If lymph precipitate or coagulum does stain, it is clearly of importance to determine what form it takes in the section, granular, reticular or alveolar.

The first method employed consisted in smearing frog's lymph on a slide, plunging it into mercuric solution and passing it through different stains. Such films gave a granulo-reticular appearance strongly stained and quite similar to many ordinary cell protoplasms. The absence of any control as to thickness of film, however, makes this method inapplicable to rigid comparison with appearances of protoplasm in sections of known thickness. In order to meet this difficulty, although possibly introducing others, the author inserted small bits of dry pith into the lymph sac of a frog, and after these had become saturated with lymph they were removed and with similar sized bits of other tissues were passed through various histological processes and sectioned in paraffin. Thus sections of tissue and of lymph coagulum, filtered through the walls of pith cells, were obtained, of equal thickness and comparable in every way.

Compared thus with cells of nerve, muscle and gland the chief result is that lymph furnishes to empty pith cells a histological content strikingly similar to certain structures usually ascribed to protoplasm. Recently Fischer, by injecting pith with chemically prepared solutions of proteids, peptones, *et al.*, proved that a number of reagents precipitated these proteids in the form of granules not to be distinguished from Altman's 'Elementarorganismen.' It thus becomes manifest that the granular factor in cell protoplasm may be readily accounted for as a simple artefact formed from solutions and not necessarily as preformed in the cell. In the author's experiments on lymph in which osmic acid, Flemming's solution, mercuric chloride, gold chloride and alcohol were used for hardening, the character of the precipitate was chiefly reticular or alveolar. In alcohol and mercuric chloride this is fine and appears under ordinary powers as vacuolated granular protoplasm. In osmic solutions it is coarsely alveolar with dense accretions of stained matter at the angles of the alveoli. Gold chloride gives a striking fibrillar reticulum with frequent sharply defined granules, resembling the varicosities and end balls often described in connection with nerve fibrils.

A number of stains have been tried. The carmines and hæmatoxylins are strongly retained, as are most of the anilins, eosin, fuchsin and nigrosin, and even methyl blue and safranin are retained quite strongly. Comparison with cells of different tissues prepared side by side with the lymph from the same frog would thus indicate that a considerable proportion of the substance stained in the cell protoplasm can not be differentiated from lymph by the stains thus far employed. It is true that identity of staining cannot be taken to prove identity of substance; but until other methods of analysis prove either identity or difference, we must admit the possibility that a large factor in what is ordinarily described as the granulation or reticulation of cell protoplasm may be simply precipitate in the cell of lymph common to the whole body. Until such analysis is made, further work upon the finer 'structure' or even on the 'content' of the so-called 'protoplasm' can have little permanent value. A point of special importance is that the nucleus stains by almost all methods in a way to differentiate it sharply from lymph precipitate. These reactions would disprove all ideas tending to make the nucleus a lymph space in the cell.

9. C. F. HODGE (for J. R. Slonaker): *Demonstration of the comparative anatomy of the area and fovea centralis.*

Methods for preserving the eye and for the demonstration of the retina in the eye as a whole and in microscopical sections were briefly discussed and a large number of specimens were exhibited. The general summary of the forms thus far studied may be made as follows:

Mammals possess an area as a rule; in some, however, notably the dog, no area can be distinguished. The primates are the only class in which a fovea is present.

All birds examined, except the chicken, have one or two well-defined foveas with areas of various forms. In the domestic chicken no trace of fovea or area has been observed. Both the quail and partridge have well-developed foveas. Among the birds studied, the following have a central fovea with circular area: turkey, duck, partridge, quail, pigeon, song and English sparrow, kinglet, robin, bluebird, and crow. The goose and ring-neck plover possess a central fovea and a band-like area. In the tern we find two foveas and a band-like area extending horizontally across the retina. One of the foveas, corresponding in position to the human fovea (nasal) is situated near the optical axis and within the area. The other fovea (temoral) is located above the band-like area and close to the *ora serrata*. Its position would indicate that it serves for binocular vision. Both the sparrow hawk and the red-tailed buzzard hawk possess two foveas, each one surrounded by a well-defined circular area and connected by a slightly developed band-like area. The foveæ in the hawks are much closer together than in the tern and are both comparatively near the optical axis, the temporal fovea apparently moving towards the center of the eye as the position of the eye in the socket changes from the lateral to the frontal type. The kingfisher resembles the hawks in the above particulars.

As to the reptiles, amphibia and fishes, the turtle and frog have band-like areas extending across the eye horizontally just above the nerve. These are not marked by any thickening of the retina, but by a closer packing together of the cells, especially well seen in the ganglion cell layer. In none of the fishes examined has either area or fovea been found. The retina is, however, much thickened over the superior half.

10. G. C. Huber: *The ending of the chorda tympani in the sublingual and the submaxillary glands* (*with demonstrations*).

The observations reported were made on preparations obtained from young dogs and puppies; the tissues were stained with the double Golgi-Cajal method and the Ehrlich-Bethe methylene blue method. The following conclusions were reached:

1. The cells of the sublingual and the submaxillary ganglia are multipolar in type; they belong to the sympathetic system; this is shown in preparations impregnated with chrome silver.

2. The axis cylinders of the sympathetic cells follow the larger and smaller gland ducts and form a plexus about the intralobular ducts. From this plexus fibres are given off that form a second plexus about the alveoli outside of the *membrana propria*. From this second plexus ultimate fibrillæ pass off, penetrate the *membrana propria* and end on the gland cells.

3. The chorda tympani consists of fibres, some of which end in the form of a pericellular end-basket around the cells of the sublingual ganglion, while others have no connection with this ganglion, but end in a similar manner in the submaxillary ganglion. No fibers of the chorda tympani end on the gland cells.

4. The sympathetic fibres following the branches of the submaxillary artery are axis cylinder branches of the sympathetic cells in the superior cervical ganglion. As far as has been determined, they end on the blood vessels.

11. G. W. Fitz: *A working model of the eye.*

Dr. Fitz showed a working model of the eye consisting of a skeleton eye set in gymbals to allow for free motion in vertical and horizontal planes. The front of the eye carries an elastic lens, made by fastening a sheet of gelatine over a water chamber with a glass back. The gelatine is bulged more or less, as the water pressure in the chamber is increased or diminished by raising or lowering the reservoir connected with it by rubber tubing. A portion of the retina is represented, including the yellow and blind spots and serves the purpose of a screen for receiving the images of candles used with the model for studying the optics of vision.

The optical conditions involved in normal vision, accommodation to near and far objects, the use of the iris, near and far sight and correction by lenses, the blind spot, corresponding points of retinæ (two models), binocular vision and convergence, estimation of distance, Scheiner's experiment, etc., may be experimentally studied with the model.

12. J. G. CURTIS: *A method of recording muscle curves.*

Dr. Curtis briefly referred to a method of recording muscle curves so that they shall be visible to a large lecture class, such as commonly calls for the use of the duBois 'muscle telegraph.'

The shaft of a muscle lever of Tigerstedt's form is replaced by a stout and very long straw which shall magnify the contractions as much as possible. In a cleft in the free end of this straw is stuck a piece of leather, which is to 'write' upon a drum turned simply by hand. The leather should be about 2½ centimetres long, and 8 to 10 millimetres wide, the length of the leather lying in the length of the straw. The leather should be flexible, but thick enough to be moderately elastic; its rough side should be turned toward the drum, and longitudinal cuts, each about 6 to 8 millimetres deep, should be made with scissors in its free end, so as to divide what is to answer to a 'writing point' into five or six fingers.

The straw lever should be placed normal to the drum and pushed directly toward the latter until the cloven end of the leather not only touches the drum, but is deflected rather sharply in the direction toward which the latter is to revolve.

If now the drum be made to revolve by band, there may be recorded very sufficient muscle curves, each made up of several neighboring parallel lines, which lines are visible together at a distance as a white band from 4 to 10 millimetres wide.

13. G. N. STEWART: *Measurements of the circulation time of the retina.*

Dr. Stewart demonstrated for the particular case of the retina a method of measuring the circulation time employed by him for various vascular tracts. A solution of methylene blue in normal saline was injected into the central end of one jugular vein of a rabbit. The retina on the other side was observed with the ophthalmoscope, and the interval between the appearance of the blue in the central artery and in the central vein measured with the stop-watch. The following is a specimen experiment:

Rabbit, 1360 grms, in weight.

Circulation time from central artery to central vein of retina, 1.75, 1.8, 1.7, 1.95 seconds. Last seen to be rather too long.

Circulation time from jugular vein to retinal artery, 4.05 seconds.

Circulation time from jugular vein to carotid artery, 2.8 seconds.

Circulation time from jugular vein to retinal artery, 3.8 seconds.

Circulation time from retinal artery to retinal vein, 1.8 seconds.

Circulation time from retinal artery to retinal vein, 1.85 seconds.

Circulation time from jugular vein to retinal artery, 4.0 seconds.

Circulation time from jugular vein to carotid artery, 2.25 seconds.

Circulation time from jugular vein to carotid artery, 2.5 seconds.

14. T. W. Mills: *Cortical cerebral localization in certain animals.*

The paper was a report on the above subject confined chiefly to birds and one rodent, the rabbit. The work will be extended to other rodents.

Birds: The author finds that stimulation of the cortex will not produce movements of the head in birds, as stated; that the effect on the pupil is not constant but variable; that it is not always confined to the opposite side, though it is usually most pronounced on that side; that there is one invariable effect of stimulating the cortex of birds, viz: drawing of the nictitating membrane over the eye ball to a greater or less extent, dependent upon the strength of the stimulus. This result is not mentioned by other investigators, and the author cannot confirm most of Ferrier's statements regarding the results of stimulating the cerebrum of the pigeon. His own experiments were made on fowls and pigeons, chiefly the latter, and on both pure-bred and common specimens.

Rabbit: As regards the rabbit, the author had been unable to find a cortical centre for the hind leg, though such a centre is clearly mapped out by Ferrier. He had no difficulty in all cases in getting cortical localization of movements of the head, mouth parts, fore limbs, etc., in the rabbits. He had used a great variety of animals of different ages, and both pure-bred and cross-bred animals.

In the dog, cat and all the animals the writer had examined, he was convinced that the definiteness of the limits of centres had been exaggerated and that probably new explanations of 'motor centres' would require to be constructed. Definiteness of localization is unquestionably found to increase, however, as one ascends the animal scale.

15. W. T. Porter: *A new method for the study of the intracardiac pressure curve.*

Two methods are now used to record the changes of pressure in the heart. In one the manometer and the tube connecting it with the heart are filled with liquid, to the exclusion of air; in the other the distal portion of the tube contains air. In the former method the advantage gained by employing an incompressible fluid is diminished by the inertia introduced by the weight of the liquid column. In the latter the lessening of inertia by substituting air for water in a part of the tube is more than offset by the loss of time unavoidable in the registration of very rapid changes of pressure by a compressible medium. The errors inherent in these two methods explain the many opposing opinions regarding the form of the intracardiac pressure curve and the filling and emptying of the heart. A theoretically perfect method requires the use of an incompressible fluid and an absence of inertia. In the new method offered by Dr. Porter these conditions are both fulfilled.

A stopcock worked by an electro-magnet is placed in the tube connecting the ventricle with the manometer that is to write the pressure curve. The current which opens the stopcock is made by a second manometer, also connected with the ventricle, driving a wire, fastened on its lever, into two mercury cups, as the pressure in the ventricle rises. By adjusting the wire the circuit can be made at any point in systole. If made near the summit of contraction the stopcock will be opened only during the maximum of ventricular contraction, and the manometer will write only the top of the intraventricular curve, for example, the last twentieth of the rise in pressure. The inertia error caused by the liquid in the manometer and the connecting tube passing through one-twentieth its usual rise is so slight as practically to disappear. The true summit of the intraventricular curve is thus secured, free of inertia error. This summit is seen to be a straight line, parallel or nearly parallel with the atmospheric abscissa.

16. S. J. MELTZER: *On the mode of absorption from the peritoneal cavity in rabbits.* (With I. Adler.)

In the recent literature on the physiology of absorption a number of writers have expressed the surprising opinion that the lymphatics assist but little in the absorption from the serous cavities. With regard to this question Meltzer and Adler made two sets of experiments on rabbits. In the first set 100 cc. of a saline solution were introduced into the peritoneal cavity (the animals were always well narcotized), and removed again after 40 minutes. In order to exclude the lymphatics, in some rabbits the innominate veins were ligated. While in a large number of normal rabbits the quantity absorbed in 40 minutes was about 35 cc.; in those with ligated lymphatic ducts it was about 18 to 12 cc. The authors, however, avoid drawing the conclusion from these experiments that the lymphatics are of great importance to the absorption, since some normal rabbits showed poor absorption, and, in fact, in two cases more fluid was taken out than was put in. In the other set of experiments for each rabbit with ligated innominate veins a control rabbit was taken, whose external jugular veins were ligated. Both animals were alike in regard to the venous stasis of their brains, but differed as to their lymphatics; in one they were excluded, and in the other they were not. The same dose of strychnine was injected into the abdominal cavity of each; the one with the lymphatics open had a tetanic attack, the other was attacked either not at all or much later. The same was seen when about 1.5 cc. of 5 % potassium ferrocyanide was injected, and the urine was tested. The Prussian blue reaction appeared in the rabbit with ligated lymphatics, an hour or an hour and a half later than in the rabbit with open lymphatics. This shows distinctly what importance the lymphatics have for the absorption from the peritoneal cavity.

17. S. J. MELTZER: *On the incorrectness of the often quoted experiments of Starling and Tubby with reference to the mode of absorption from the peritoneal cavity in dogs.*

As an important argument for the theory that the fluid from the peritoneal cavity enters the circulation directly through the walls of the blood vessels and not by the long way of the lymphatics, the experiments of Starling and Tubby are often quoted. Starling and Tubby have made only three experiments, and have published one protocol only, which is in the main as follows: 40 cc. of indigo carmine were introduced into the abdominal cavity; 2 minutes after the injection the urine was dark blue, while a half hour later the lymph showed a bluish tinge. Meltzer has repeated these experiments and found quite a different result. Potassium ferrocyanide or indigo carmine appeared in the lymph from the thoracic duct about 14 minutes after their introduction into the peritoneal cavity, but in the urine only after an hour or more. Moreover, even after the injection of indigo carmine directly into the circulation, 23 minutes elapsed before the urine became blue.

18. F. S. LOCKE: *On the action of ether on contracture and on positive kathodic polarization of voluntary muscle.*

Mr. Locke described experiments, the graphic records of which were shown, in which the action of ether on striated muscle under the influence of various contracture-conditioning agents was investigated. Under etherization the normal twitch of short duration reappears. The relation of this result to Biedermann's positive kathodic polarization of striated muscle was pointed out, reasons for considering which undemonstrated were given.

19. H. G. BEYER: *On the influence of exercise on growth.*

Dr. Beyer spoke of the necessity of applying more exact methods of investigation to the study of this very important physiological subject than had been done hitherto. While acknowledging that some of the more general good effects of all forms of exercise were within the easy reach and the experience of all, the more remote and permanent ones must be made the subject of more serious study and investigation.

He described one of the methods by means of which the influence of systematic gymnastic or of other forms of exercise might be ascertained, and presented the results of some investigations in this direction. For example, as to height, his figures presented strong evidence that height is decidedly increased by exercise taken within physiological limits and during the period of growth.

20. W. H. HOWELL (for Messrs. Conant and Clark): *The existence of a separate inhibitory and accelerator nerve to the crab's heart.*

The work was done upon the common edible crab, *Callinectes hastatus.* The authors have been able to show that two separate nerves pass from the thoracic ganglion to end in a plexus in the wall of the pericardium and that one of these nerves, when stimulated, inhibits the heart beat, while the other causes marked acceleration. The inhibiting nerve was traced anatomically to the ganglion, which it joins in company with the large mandibular nerve. The junction of the accelerator nerve with the ganglion has not so far been demonstrated anatomically, but the physiological evidence indicates that it leaves the ganglion in company with the nerve to the first pereiopod. If this latter nerve is severed from the ganglion, stimulation of the ganglion no longer gives acceleration. If the peripheral end of the severed nerve, however, is stimulated, marked acceleration is obtained. If, moreover, the severed nerve is again cut a little farther to the periphery, stimulation of the new peripheral end no longer affects the heart, while stimulation of the small isolated piece thus obtained gives acceleration. This evidence indicates that the accelerator nerve leaves the nerve of the first pereiopod a short distance, about 1 centimetre, beyond the thoracic ganglion. As stated above, in the neighborhood of the pericardial plexus it is easily found as a separate nerve lying close to the inhibitory nerve. The authors were not able to obtain any evidence of a tonic activity of either of these nerves. Stimulation of the cerebral ganglion with strong currents gave inhibition of the heart, which disappeared, however, when the commissures connecting this ganglion with the thoracic ganglion were cut.

21. FR. PFAFF: *On toxicodendrol and on the so-called toxicodendric acid.*

'Toxicodendric acid' has been regarded heretofore as the active principle of poison ivy, *Rhus toxicodendron.* Dr. Pfaff isolated this acid and analyzed its barium and sodium salts. Quantitative and qualitative tests show that it is really nothing but acetic acid. The true active principle of poison ivy is an oil named by Dr. Pfaff *Toxicodendrol.* The purity of the oil obtained was proved by quantitative analyses of the lead compounds with different preparations of the oil.

22. H. C. CHAPMAN: *Methods of teaching physiology.*

Professor Chapman gave a demonstrative talk upon methods employed in his own teaching, illustrating his remarks largely by apparatus devised by himself. He urged the value of the comparative method and showed a valuable series of Mammalian brains, together with other comparative anatomical preparations.

The following new members were elected:

J. G. Adami, M. A., M. D., M. R. C. S., Professor of Pathology, McGill University.

T. B. Aldrich, M. D., Instructor in Physiological Chemistry, Johns Hopkins University.

J. McK. Cattell, Ph. D., Professor of Experimental Psychology, Columbia College.

G. P. Clark, M. D., Professor of Physiology, Syracuse University.

R. H. Cunningham, M. D., Assistant Demonstrator of Physiology, College of Physicians and Surgeons, Columbia College.

G. W. Fitz, M. D., Assistant Professor of Physiology and Hygiene, Harvard University.

T. Hough, Ph. D., Assistant Professor of Physiology, Massachusetts Institute of Technology.

R. Hunt, A. B., Fellow in Physiology, Johns Hopkins University.

F. S. Locke, M. A., M. B., Instructor in Physiology, Harvard Medical School.

Professors C. S. Minot and C. F. Hodge were appointed to express to Prof. Langley the opinion of the Society that it is highly desirable that the table of the Smithsonian Institution at the Naples Zoölogical Station be continued. Mr. W. B. Saunders entertained the members of the Society at luncheon at the Art Club. The Society enjoyed also the courtesies that were extended to the affiliated societies by the University of Pennsylvania and the Philadelphia Local Committee.

Officers for the coming year were elected as follows: Members of the Council, H. P. Bowditch, R. H. Chittenden, W. H. Howell, F. S. Lee, J. W. Warren; President, R. H. Chittenden; Secretary and Treasurer, F. S. Lee.

The President and the Secretary were appointed respectively Delegate and Alternate to the Congress of American Physicians and Surgeons of 1897.

FREDERIC S. LEE,
Secretary.

THE PHILADELPHIA MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION.

AT the Princeton meeting of the Association a year ago overtures of affiliation were received from the American Society of Naturalists, and in response to these the meeting of 1895 was held at the same time and place as those of the affiliated societies. The opportunities thus afforded of seeing and hearing distinguished representatives of kindred lines of investigation added much to the interest of the psychological program, while the abundant hospitality of the local committee provided for the social contact, which is rightly an important feature of all such gatherings.

On opening the first session of the Association, the President, Prof. Cattell, of Columbia, introduced Prof. Fullerton, Dean of the University of Pennsylvania, who first welcomed the Association to the University and then read a paper on *Psychology and Physiology.* In it he drew the boundary between the two sciences sharp, not with any view to warning off mutual trespass, but to having the writers of text-books keep clear for their readers the essential limits of both sciences. With Foster's Physiology as a text Prof. Fullerton showed what lavish use is made in the chapters on the functions of the sense organs and the nervous system of material that is patently psychological, *i. e.*, secured by the distinctly psychological method of introspection. This paper appears in full in the current number of the *Psychological Review.*

Prof. Fullerton was followed by Dr. Farrand, of Columbia, who described a *Series of Physical and Mental Tests on the Students of Columbia College.* The tests described are made on the undergraduates of the College at entrance, and repeated upon the same students at the end of their Sophomore and Senior years. The object of the tests is to obtain a record for comparative purposes of certain mental and physical characteristics of the students at different times during a period of rather active intellectual growth, and at the same time to furnish material for a statistical study of the particular points examined. Stress is laid to a certain extent upon the more purely mental inquiries, such as memory, rate of perception, and motor response, accuracy of perception, color vision, etc., but enough physical tests are included to afford a comparison between bodily and mental development if any relation between the two exists. Dr. Farrand's paper led to a discussion of the advantages of such prolonged statistical inquiries, at the conclusion of which, on motion of Prof. Baldwin, of Princeton, the Association voted to appoint a committee to consider the matter of the coöperative collection of such data by the various psychological laboratories. This committee, as announced at the business meeting, is composed of Professors Baldwin, Jastrow, Sanford, Witmer and Cattell (chairman).

Dr. Arthur MacDonald's paper on *Some Psycho-Neural Data* was a report upon experiments similar to those reported on by the same speaker at the Princeton meeting (see SCIENCE, I., 43), but this time including, besides experiments upon pain, others on discriminative sensitivity of the skin (Weber's circles), and just observable differences in warmth. The experiments were regarded rather as tests of tests than as leading to definitive results, but they nevertheless appeared to indicate some interesting relations, of which the most general were the greater general sensitiveness of the left side as compared with the right, the greater sensitiveness to pain of women as compared with men, and the greater sensitiveness of young men of the wealthy classes both to differences in locality (Weber's circles), and to pain as compared with men in the Boston 'Army of the Unemployed.'

Mr. Oliver Cornman, the next speaker, reported upon *An Exprimental Investigation of the Processes of Ideation*, a study upon school children undertaken under the direction of Prof. Witmer. The children were asked to write as many words as possible in an interval of fifteen minutes, writing the words in columns. In general lists of from 200 to 400 words result, which are then classified and subjected to statistical treatment. It has been found that the directions given the children at starting are extremely important in determining the flow of associated words, and that the last third of the fifteen-minute period gives results most indicative of the individuality of the child. This investigation is understood to be still in progress.

The session of Friday afternoon was opened by the *Presidential Address* of Prof. Cattell, of Columbia College, who described the history and recent progress of psychology and the part played in its development by experiment and measurement. Psychology is by no means a new science, but its growth during the last few years has been rapid, and it now rivals the other leading sciences in productiveness of research and publication and in academic position. Science is either genetic or quantitative, and psychology is advancing in both directions. The problems that can be treated in the laboratory were reviewed, and it was claimed that these have added directly and indirectly new subject matter and methods, have set a higher standard of accuracy and objectivity, have made some part of the subject an applied science with useful applications, and have enlarged the field and improved the methods of teaching psychology. In conclusion, the relations of psychology to the other sciences and to philosophy were reviewed and their interdependence was emphasized. The address will be printed in the March number of *The Psychological Review.*

The President's address was followed by an informal communication from Prof. Ladd, of Yale, upon the *Direct Control of the Retinal Light.* After a description of the phenomenon (upon which the speaker has contributed a brief paper to the *Psychological Review*, I., 351) a syllabus of simple experiments for observing it was distributed and coöperative aid in its study solicited.

The next speaker was Prof. Strong, and his topic *Consciousness and Time.* The paper was a critique of the views presented in the Presidential address of Prof. James at the Princeton meeting. It was then argued that the perception of passing time involved a successive unity of consciousness in addition to the simultaneous unity required for the perception of likeness and difference. Prof. Strong, on the contrary, held that a successive unity is an impossibility, and that the consciousness of succession being in its nature retrospective, all knowledge of passing time must be representative, thus making the ordinary simultaneous unity of consciousness all sufficient. This paper will appear in the *Psychological Review.*

The afternoon session concluded with the paper of Brother Chrysostom on *Some Conditions of Will Development.* These conditions, the speaker considered, fall under two heads: the instrinsic, or such as depend on the voluntary agent, and the extrinsic, or such as act on him from without. The first of the intrinsic conditions is the nature of the will itself, which is indeterminate, at least as to the means that it shall employ. Objection to this view based on 'Double Consciousness' does not hold. The will is, however, determined to a certain extent by habit and intellect, and heredity and environment exercise a marked influence upon it. Environment itself, however, is partly subject to will and herein lies the great opportunity of ethical improvement.

The paper of Prof. Lloyd, of the University of Michigan, on *A Psychological Interpretation of the Rules of Definition in Logic,* though in the hands of the Secretary, was omitted because of the fulness of the program.

The most generally interesting and the most fully attended session of the Association was that of Saturday morning, when a discussion on *Evolution and Consciousness* brought together as participants Professors James, Cope, Baldwin, Minot and Ladd. Prof. James in opening the discussion sketched in brief the several aspects of the general question upon which psychological interest is more or less centered.

1. How ancient is consciousness in the world at large? To this question Clifford, Fechner and others have replied with a doctrine of atomic souls, making consciousness coeval with the universe, while Spencer and others again have advanced theories which place its entrance relatively late in cosmic development. The monadism of Leibnitz and the current doctrines of the soul are still other coödinate theories. 2. Is consciousness a genuine dynamic agent in the psycho-physical combination or merely an epiphenomenon? Here, it was said, the leaning of all the younger workers and of some of the elder is toward automatism, or psycho-physic parallelism, though others of the elder men still contend for a genuine effect of mind upon its bodily partner. 3. In the field of individual consciousness the question is that of nativism and empiricism; what in the consciousness of the child, for example, is inherited and what is acquired? Here the balance of current opinion dips heavily toward nativism.

Prof. Cope, of the University of Pennsylvania, who followed, spoke from the platform of zoölogical evolution. In these matters the point of view is all important. Darwin was an œcologist, Weismann and the Neo-Darwinians are mostly embryologists and their views are influenced thereby. The real history of evolution, however, the facts apart from any speculation about them, lies in the field of the paleontologist, and by him such questions must be settled.

After rapidly outlining the position of the Neo-Darwinians, the speaker indicated the sort of evidence that had led him to the opposite view. With regard to consciousness he remarked that the only systems in man that were abreast of evolutionary advance were the nervous system (the physical representative of consciousness) and the reproductive system; the rest is that of the eocene mammals. The course of evolution has, on the whole, been upward and purposeful. For this, physical and chemical forces cannot account, nor can theories of chance variation which make consciousness useless; consciousness itself has been an active participant. In the individual—at least in the representative activities of mind—consciousness may be conceived to affect the qualitative relations of the physical energy used, though not the quantitative relations. In the presentative activities, on the contrary, both are physically determined. The control in representative thinking is sufficient to make consciousness a real dynamic agent.

The next speaker was Prof. Baldwin, of Princeton, who, while concurring in the main with the previous speaker, deprecated the conception of mind as an extraneous something thrust in from without, and advocated the standpoint of monism.

Prof. Minot, of the Harvard Medical School, spoke for the Neo-Darwinians and embryologists. Admitting the facts that had been advanced by Prof. Cope in favor of the Neo-Lamarckian position, the speaker found himself unable to accept the inferences drawn from them, and totally unable to conceive how the experiences of the adult can in any way be communicated to the embryo, the development of which he was forced to look upon as regulated by purely mechanical causes. With regard to life itself, however, the tendency of present biological thought is away from purely mechanical views; living and non-living matter are not the same thing. Consciousness is coextensive with life. While it does not break into the stream of physical energy, it selects among the possible transformations of that energy and thus has its effect without being itself any form of energy.

Prof. Ladd's position was that of an unequivocal idealist. He denied that consciousness in the world or in the individual could in any way be derived from a combination or modification of physical things. The very concepts of physics, energy and the like, can be derived from consciousness alone and have no meaning apart from it. Consciousness plays an active part in the psycho-physical partnership, and the struggle for existence is a psychical struggle. He reminded psychologists further that even the physicist's cardinal principle of the conservation of energy is yet far from demonstrated for cerebral action, or even for the action of the simple nerve-muscle machine, and ventured the prediction that that principle would undergo modification at the hands of the physical scientists themselves.

The question was then thrown open for general discussion, in which Professors Fullerton, Hyslop, Strong, Miller and Mills took part; and the whole was finally concluded by brief rejoinders from several of the original speakers.

At the afternoon session on Saturday, Prof. Patrick, of the University of Iowa, reported on *An Experiment on the Effects of Loss of Sleep*. The subject of this experiment, a healthy young man, was kept without sleep for ninety successive hours. Every six hours elaborate physical and mental tests were made upon him, and at the end of the ninety hours the depth of his sleep was tested every hour through the ten and a half that he continued to sleep.

During the ninety hours of waking, the subject gained slightly in weight, though his only additional food was a light lunch taken just after midnight, but lost even more during the period of sleep that followed. The results of the tests may be briefly summarized as follows : The loss of sleep appeared to cause little loss of general mental activity; sharpness of vision, discrimination of taste sensations and possibly rapidity in reaction-times involving discrimination increased. Simple reactions, the pulse rate and the adding of figures were somewhat slowed. Muscular power was also somewhat lowered. In several of these, however, the expectation of the end of the test caused a return to near the normal during the last half day. Hallucinations of vision, due probably to the unusually prolonged stimulation of the eyes, were observed. The shortness of the period of sleep required for entire recovery gives ground for the belief that sleep is a relative matter, and that, in spite of being kept as fully awake as a man could be, the subject nevertheless was more or less of the time in a state of partial somnolence.

The second paper was a brief report by Prof. Mills, of McGill University, on *Further Researches on the Psychic Development of Young Animals and its Physical Correlation.* His researches upon pure-bred dogs reported last year have now been extended to mongrel dogs, the cat, rabbit, guinea pig and birds, and their results will soon be published. The mass of details involved prevented more than an annoucement of the work accomplished.

Prof. Witmer's paper on *Variations in the Patellar Reflex as an Aid to Mental Analysis* was next read. It contained an account of a long and elaborate study of the knee-jerk and its variations as a preliminary to its use as an index of psychical activity in studies of emotion. The varied details of the paper forbid brief presentation; certain bilateral forms of experiment, however, may be mentioned as of especial interest.

The fourth paper was that of Prof. Hyslop, of Columbia, entitled *Experiments on Induced Hallucinations.* In it were reported with critical comment a considerable set of observations by a lady of Prof. Hyslop's acquaintance, on hallucinations secured by the method of 'crystal vision.' Few or none could be traced by the observer to actual experiences, but some may have had that origin. Two or three would lend themselves to a telepathic explanation, but are by no means definite enough to have any confirmatory force in favor of such a theory. Perhaps the greatest interest in such hallucinations is the possible light which their examination may throw upon normal mental action.

The closing paper of the session was by Prof. Newbold, of the University of Pennsylvania, on *Dream Reasoning.* Three cases were described, one where the subject-matter was mathematical, one in which it was linguistic, and one in which it was archeological, the last two coming from the experience of a single person. In all three the dream reasoning lead to results that were valuable in waking life.

At the regular business meeting held after the discussion Saturday morning the following officers were elected : President, Prof. G. S. Fullerton, University of Pennsylvania; Secretary and Treasurer, Dr. Livingston Farrand, Columbia College; Members of Council, Profs. E. H. Griffin, Johns Hopkins University, and E. C. Sanford, Clark University.

The following gentlemen were elected

to membership: Prof. E. D. Cope, University of Pennsylvania; Prof. C. S. Minot, Harvard Medical School; Mr. J. E. Lough, Harvard; Dr. E. A. Singer, Harvard; Dr. N. Wilde, Columbia; Dr. C. H. Bliss, University of the City of New York; Dr. Franz Boas, New York; Mr. Warner Fite, Williams College; Prof. J. E. Creighton, Cornell; Dr. H. Austin Aikins, Western Reserve; Dr. W. G. Smith, Smith College.

The report of the Secretary and Treasurer showed a membership of sixty-five and a balance in the treasury of over $290. A vote of thanks for the hospitality received was unanimously passed. The fixing of the time and place of the next meeting was left in the hands of the incoming President in coöperation with the Presidents of the other Societies. It was voted that any members attending the meeting of the International Psychological Congress in Munich next summer should, on notification to the Secretary of the Association, be empowered to act as delegates from the Association.

Between the morning and the afternoon sessions on Saturday an informal meeting of those interested in the formation of a Philosophical Society, or the organization of a Philosophical section within the Psychological Association, was held, and at the afternoon meeting the matter was brought before the Association and by vote referred to the Council with full power to act.

Edmund C. Sanford,
Secretary for 1895.
Clark University.

TENTH ANNUAL MEETING OF THE IOWA ACADEMY OF SCIENCES.

The Iowa Academy of Sciences met for its tenth Annual session in Des Moines, January 1st, 2d and 3d, 1896, in the Horticultural rooms at the Capitol Building. The attendance and interest at this meeting surpassed all previous gatherings of the Accademy and were very encouraging.

Prof. H. W. Norris in his address as retiring President took for his subject 'Needed Changes in Scientific Methods.' The address was full of excellent suggestions, both for scientific workers and for the public, who look to scientific investigation for assistance in economic problems.

'The Homologies of the Cyclostome Ear,' read by Prof. Norris, presented evidence that the ear of Cyclostomes, though differing so markedly from that of ordinary vertebrates, is still capable of being homologized perfectly with the ear in other orders.

Prof. C. C. Nutting read a very interesting paper on 'Origin and Significance of Sex,' setting forth the theory of Geddes and Thompson as presented in their work on the evolution of sex and detailing some very interesting studies of his own on the development and determination of sex in Hydroids.

Prof. T. Proctor Hall presented papers on 'Unit Systems and Dimensions of Units,' 'Gravitation,' 'A Mad Stone.' In the last paper he described a peculiar absorptive power of the rock, being able to absorb one-half more water by volume than the rock itself.

Prof. L. W. Andrews presented the following papers: 'The Influence of Moisture on the Ignition Point of Sulphur,' and 'The Reduction of Sulphuric Acid as a Function of the Temperature.'

Prof. W. S. Franklin presented a paper on 'A New Electrical Generator for Oxygen and Hydrogen.' Prof. L. A. Youtz gave an account of the Indianola clay and pottery works.

Prof. L. H. Pammel gave an account of the flora of Western Iowa, calling attention to peculiar Western plants found on the bluffs along the Missouri river. In a second paper with Prof. F. Lamson-Scribner, he enumerated the grasses found between Jefferson, Iowa, and over the Rocky Mountains—the gradual change from blue grass in Iowa to blue stem and game grasses of the plains.

Mr. F. C. Stewart and G. W. Carver presented a paper on 'Inoculation Experiments with Gymosporangium Macropus,' in which it was shown that different varieties behave quite differently with respect to the fungus.

Prof. L. S. Ross, in a paper on 'Preliminary Notes on the Iowa Entomostraca,' showed that this interesting and economic group of animals is much neglected. His collections were made at Lake Okoboji and Spirit Lake.

Prof. T. H. McBride, in a paper on 'Forest Distribution in Iowa and Its Significance,' laid special stress on the distribution of trees in Iowa on the loess. The various theories advanced to account for the absence of trees in Iowa have some foundation and only partially explain the absence of trees. There is much in the theory of Prof. McGee on the relation of the loess to the distribution. In a second paper on 'County Parks' he advocated the establishment of county parks for the purpose of retaining some of the many wild plants once common in Iowa, and for the purpose of giving the people needed recreation.

'Recent development in the Dubuque lead and zinc mines,' by A. G. Leonard. The production from this region in 1895 was 750,000 pounds of lead and 3,500 tons of zinc. The increase is due to better mining and the recovery of ore from the 'fourth opening.'

'Some facts brought to light by deep wells in Des Moines county,' Iowa, by F. M. Fultz, detailed the discovery of certain deeply buried river channels which leads to the inference of a later origin of the drainage than previously argued by the author.

'Recent discovery of glacial scorings in southeastern Iowa,' by F. M. Fultz. Marks of the presence of the Illinois ice, in a set of striæ bearing S. 79% W., have been noted by Mr. Leverett and the author.

'The Buchanan gravels, an inter-glacial deposit in Buchanan county,' by Samuel Calvin, describes a series of gravel beds lying between the Kansan and Iowan drift-sheets and located near Independence.

'The Le Claire limestone,' by Samuel Calvin. The local variations in thickness and dip are referred to the conditions of deposition and are regarded as due to cross-bedding.

'Variations in the position of the nodes of the axial segments of the pygidium of a species of Encrinurus,' by W. H. Norton. The small classificatory value of the characteristic is shown.

'A Theory of the Loess,' by B. Shimek. The æolian origin of the deposit is advocated from a study of the loess-fossils, the timber distribution and certain field relations.

Prof. J. L. Tilton presented two papers, one on the 'Slate area of near Nashua, N. H.,' and the other 'Notes on the Geology of the Boston Basin.'

'Observations on the Cicadidæ of Iowa,' by Herbert Osborn, included a list of the known Iowa species of this family and discussion of the distribution of *Cicada septendecem* in the State.

Other papers presented or in some cases read by title were: 'Perfect Flowers in Salix,' by Prof. B. Shimek; 'Some Anatomical studies of Sporobolus and Panicum,' by Miss Emma Pammel and Miss Emma Sirrine; Contributions to a Knowledge of the Thripidæ,' by Miss Alice M. Beach; 'A Review of the Genus Clastoptera,' by Mr. E. D. Ball; 'Notes on Chromogenic Bacteria,' by L. H. Pammel and Robert Combs; 'A Brief Study of a Curious Water Organism,' by F. M. Witter; 'A Comparative Study of the Spores of North American Ferns,' by C. B. Weaver; 'Two Remarkable Cephalopods' and 'Note on the Nature of Cone in Cone,' by C. R. Keyes. 'Biologic Notes on Certain Iowa Insects,' by H.

Osborn and C. W. Mally; 'Anatomy of Sphærium sulcatum,' by Gilman Drew; 'Fungus Diseases of Plants at Ames,' by L. H. Pammel and G. W. Carver; 'Notes on the Remains of Elephas and Mastodon,' by S. W. Beyer.

These papers will, with few exceptions, appear in the Academy proceedings which will be issued at as early a date as possible. The Academy is in a very flourishing condition, having now something over one hundred members. Its proceedings are published by the State and it is incorporated under State law. Its library and exchanges have grown rapidly in recent years, and there is every season to believe it will have a decided influence in advancing the cause of scientific research in the State.

The following officers were elected for the coming year: President, T. Proctor Hall; 1st Vice-President, W. S. Franklin; 2d Vice-President, T. H. Macbride; Secretary and Treasurer, Herbert Osborn; Additional members of the Executive Committee, W. S. Hendrixson, M. F. Arey, W. H. Norton.

HERBERT OSBORN,
Secretary.

CALIFORNIA SCIENCE ASSOCIATION.

THE second annual meeting of the California Science Association was held in Oakland, January 3 and 4, 1896. President Jordan, of Stanford University, delivered the annual address as President of the Association on 'The Foundation of Belief.'

The following list of papers was read:

1. *A Memoir of Dana:* JOSEPH LE CONTE.
2. *The Action of Anhydrous Ammonia and Anhydrous Aluminium Chloride:* J. M. STILLMAN.
3. *A Quantitative Separation of Iodine from Chlorine:* M. ADAMS.
4. *A Plea for an Aero-Physical Observatory on Mt. Tamalpais:* A. MCADIE and W. H. HAMMON.
5. *Notes on the Accuracy of refractive Index Determinations:* D. W. MURPHY.
6. *The Manufacture of Artificial Food Products:* S. W. YOUNG.
7. *The Maintenance of Constant Temperatures:* S. W. YOUNG.
8. *A Modification of the Bunsen Ice Calorimeter:* F. SANFORD.
9. *A Relief Map of California:* N. F. DRAKE.
10. *A Relief Map of Oregon:* S. SHEDD.
11. *Some Lecture Experiments in Chemistry:* W. B. RISING.
12. *On Micro-chemical Analysis:* W. B. RISING.
13. *Use of Hydro-bromic Acid in the Estimation of Mercury and Cinnabar:* W. B. RISING and V. LENHER.
14. *Chemical Behavior of Liquid Hydroiodic Acid:* F. G. COTTRELL and R. S. NORRIS.
15. *The Criterion of Continuity:* IRVING STRINGHAM.
16. *Logarithmic Orthomorphosis:* IRVING STRINGHAM.
17. *The Nine-Point Rectangular Hyperbola:* A. V. SAPH.
18. *Simplification and Extension of Gauss's Third Proof of the Fundamental Theorem of Algebra:* M. W. HASKELL.
19. *Note on Fermat's Theorem:* M. W. HASKELL.
20. *Notes on the Imaginaries in Plane Coördinate Geometry:* R. L. GREEN.
21. *Note on Partial Differential Equations:* R. E. ALLARDICE.
22. *Notes toward the Life History of the 'Water Dog' or California Newt (Diemyetylus torosus):* W. E. RITTER.
23. *A few Observations on the Hydroidea of San Francisco Bay, particularly concerning their Reproduction:* W. E. RITTER AND H. B. TORREY.
24. *Respiration in Women:* MISS C. D. MOSHER.
25. *Effect of Variation of Temperature on Muscle Irritability:* R. L. WILBUR.
26. *Refractory Period in an Isolated Strip of Cardiac Muscle of the Turtle:* MISS E. BRIGGS.
27. *Note on the Structure of the Brain of Embryo of Gerrhonatus:* A. B. SPAULDING.
28. *The Development of the so-called Phosphorescent Organ of Porichthys notatus:* C. W. GREENE.
29. *Note on the Function of the Air Bladder of Porichthys notatus:* C. W. GREENE.
30. *Latitude and Vertebræ in Fishes:* D. S. JORDAN.
31. *Distribution of Trout in California:* D. S. JORDAN.
32. *Some points in Plant Geography:* E. W. HILGARD.
33. *A New California Liverwort:* D. H. CAMPBELL.
34. *Some Facts concerning California Tunicata:* F. W. BANCROFT and W. E. RITTER.
35. *The Mallophaga:* V. L. KELLOGG.
36. *Explorations of the U. S. Fish Commission in 1895:* O. P. JENKINS.
37. *A new form of Microtome:* O. P. JENKINS.

The officers elected for the ensuing year are: Chas. H. Keyes, *President;* Irving

Stringham and Fernando Sanford, *Vice-Presidents;* M. W. Haskell, *Secretary;* R. L. Green, *Treasurer;* John D. Parker, *Custodian.* These, with the former Presidents, Joseph Le Conte and David Starr Jordan, constitute the Executive Committee.

The next meeting will be held at the State University in Berkeley.

M. W. HASKELL,
Secretary.

CURRENT NOTES ON PHYSIOGRAPHY.

ANNUAL RANGE OF TEMPERATURE OF THE OCEAN SURFACE.

THE annual range of temperature in the lower atmosphere, first clearly charted by Supan (Zeitschr. für wissensch. Geogr., 1880) and more recently by Conolly (see my Elementary Meteorology, fig. 18), is recognized as an important climatic factor, and the distribution of its larger and smaller values brings forward several interesting physiographical generalizations. Dr. G. Schott now presents a similar chart for the annual range of temperature of the ocean surface (Pet. Mitt., July, 1895,) from which it appears that the maximum range, 15° to 20° C., occurs on latitude 40° N., next east of the continents. Belts of large range, 5° to 7° in the southern hemisphere, 8° to 12° in the northern hemisphere, run around the oceanic world about 38° north and south, that is, under the belt of high atmosphere pressure and prevailingly clear skies; and small ranges are generally found around the equator, 1° to 3°, and in high latitudes, 2° in the far southern ocean, 4° to 6° in the far north. Dr. Schott ascribes the maximum ranges to the oscillation of cold and warm currents; and to this the contrast between the off-shore winds of summer and winter, by Nova Scotia and Corea, may fairly be added. Locally increased ranges on the equator, up to 5° or 6°, west of Africa and South America, are explained by the weaker and stronger flow of the South Atlantic and South Pacific eddies in the southern summer and winter.

WINDS OF THE PACIFIC OCEAN.

THE mean strength of the winds over the Pacific Ocean is discussed by Köppen in the *Annalen der Hydrographie* (July and August, 1895), in preparation for the publication of a *Segelhandbuch.* The velocities, without regard to directions, are presented in tabular form and in charts for the opposite seasons of January–February and July–August. Apart from the practical value of these results to navigation, they present interesting features characteristic of the planetary and terrestrial schemes of atmospheric circulation. Where the material is most plentiful, one may easily recognize the weak winds and calms of the planetary system around the equator, between the steady trades on either side; the frequency of calms again, but also of stronger winds in the horse latitudes, about 30° north and south; and the rapid increase of strong winds in the higher latitudes of the prevailing westerlies. Terrestrial features appear in the annual migration of these wind belts, not however symmetrically about the equator, but about a medial line in perhaps 5° north latitude; and also in the seasonal variation of the strength of the westerlies, from over 4 (Beaufort scale) in summer to over 5 in winter in the northern temperate zone, from over 5 to over 6 in the far southern zone. The irregularities of the planetary belts and of the terrestrial migrations may, in great part, be plausibly referred to cyclonic disturbances, but need much further investigation. The light equatorial winds shift south of the equator only near Australia, where monsoon winds and a seasonal counter current may be searched for.

ABNORMAL AND SOLITARY WAVES.

REPORTS are not infrequently made of waves or 'seas' of exceptional size, erroneously called 'tidal waves,' by which vessels are overwhelmed on the open ocean. C. E. Stromeyer gives brief account of some examples in *Nature* (li., 1895, 437), describing them as strong enough to carry masts and funnels by the board, and to smash bulwarks, lifeboats and deck houses. He suggests that the waves may be due to volcanic action in the submarine bank known as the Faraday reef, northeast of Newfoundland, for in a number of cases the course of the waves is away from the reef. The same subject is continued by W. Allingham in the (London) *Nautical Magazine* (lxiv., 1895, 539–545), many examples being given. The *Vancouver*, of the Dominion line, was badly mauled by a solitary sea while crossing the North Atlantic in 1890. The *Holyrood*, in June, 1892, 20°N, 35°W, encountered a solitary sea which looked like a wall of water as it approached; it flooded the decks, but before and after this sea broke, the water was comparatively smooth under a light northeast trade wind. The *St. Denis*, New York to Yokohama, in September, 1893, 28° S, 8° E, was boarded by a solitary sea which swept her decks and carried away three seamen. The *Normannia*, 750 miles out from New York, January, 1894, suddenly encountered a sea 'running masthead high,' submerging the vessel up to her bridge, and doing great damage.

Similar phenomena of smaller dimensions are reported on our great lakes. So little is known of them that no satisfactory explanation of their occurrence can be at present adopted. W. M. DAVIS.

HARVARD UNIVERSITY.

TYPES OF LOWLAND COASTS.

As the opening paper to the Richthofen Jubilee volume (Festschrift Ferdinand Freiherrn von Richthofen, von seinen Schülern. Berlin, 1893), Dr. Alfred Philippson, of Bonn, contributed a discussion of type forms of coasts, particularly of alluvial coasts (Uber die Typen der Küstenformen, insbesondere der Schwemmlandküsten).

Under 'die cüste' he includes a zone on either side of the shoreline. He describes as 'Isohypsenküsten' those coastal forms which have been produced by the various constructional processes, such as deformation, depression of land, uplift of sea bottom, volcanic and glacial aggradation. These forms vary so greatly that one can make of them as many types as one pleases.

The present writer prefers to call this class of shore forms 'Constructional,' for in cases of tilted or warped crustal movement the new shoreline does not coincide with a former contour (Isophypse). Philippson recognizes that development must follow the constructional stage, and coastal irregularity from differential marine erosion is therefore explained, and the minute forms of beach profile are illustrated with five diagrams. He amplifies with illustrations his terms, potamogenous or river-made and thalassogenous or sea-made coasts, first introduced in connection with his work on Greece.* Though he introduces the idea of systematic change in the geographic form of coasts, as in 'incompletely potamogenous' and 'completely potamogenous' alluvial coasts, he does not fully carry out this idea and make a systematic account of all successive stages of development. It would make the comprehension of the various forms of coasts much easier to introduce the terms already applied to land forms and speak of a coast as young, adolescent or mature. F. P. G.

CURRENT NOTES ON ANTHROPOLOGY.

SKIN PAINTING IN SOUTH AMERICA.

AT the last session of the Italian Geographical Congress, an interesting paper was read by Guido Boggiani, on the supposed tattoo marks on Peruvian mummies.

* Peloponnes, Berlin, 1892, p. 509.

Various authors (Virchow, Danielli, Joest) have spoken of these colored decorative marks as true tattooing. Boggiani, however, by a closer examination of them, reaches the opinion that they are paintings. The materials used are various, as ferrous oxide, cinnabar and the juice of the *Bixa orellana*; but that which produces the peculiar tattoo-like appearance is the juice of the *Genipa oblongifolia*, a sort of indigo fluid, blue at first and turning black on exposure. It has a slight corrosive action on the skin, attacking the tissues of the epidermis, and thus gives to the marks which it leaves singular permanency, and the appearance of tattoo cicatrices.

The article of Boggiani is well illustrated, and is conclusive in establishing the prevalence throughout large areas in South America of the use of this plant.

ÆSOP IN AZTEC.

NATIVE Mexican, that is, Nahuatl or Aztec literature, is increasing to a respectable extent. Scarcely a year passes that some product of the printing press appears in this ancient and rich language. One of the latest is the Fables of Æsop, published by Dr. Antonio Peñafiel, from a sixteenth century translation. It is a pamphlet of 37 pages on good paper and in clear type.

No certainty has been reached as to the translator. It may have been Father Sahagun, but I am inclined to Father Bautista or some of his associates in the college at Tlatelolco, where the native youth were instructed in humanities and religion. It was probably intended as a reading book for them, and the forty-seven fables it contains, rendered into the Nahuatl of that early day, may still be followed as models of grammatical purity.

THE READING OF QUIPUS.

IT is well known that the ancient Peruvians had a method of preserving their records by means of strings, varied in hue, of different lengths and texture, and knotted in sundry designs. The early historians offer no clear explanation of them, and differ widely in estimates of their value as records of facts and ideas. They were called *quipus* —cords.

It appears that they are still in use, and Dr. Uhle, in the Ethnologisches Notizblatt, of the Museum of Ethnography, Berlin (Heft 2, 1895), explains several which he found among the shepherds about Lake Titicaca. They relate to the animals under their care. The color indicates the sex, or some other special series. The system is decimal, the position indicating the tens and hundreds. Those examined proved to be merely mnemonic aids, based chiefly on arithmetic ideas, and apart from these unintelligible by themselves. Doubtless the ancient *quipu* readers extended their use to all the needs of life in this direction, but their principles of interpretation must have been the same. D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMICAL.

THERE are numerous cases in astronomical literature where astronomers have rejected certain observations because they did not agree with their own. But it is really not often that we find an astronomer gravely rejecting an observation simply because it *did* agree with his own. In one of his recent double star orbit discussions, Dr. See, of Chicago, omitted to use certain observations of Prof. Knorre. Dr. Brendel objected to this omission on the part of Dr. See, in a recent number of the *Astronomical Journal*. Now Dr. See replies, in the same journal, that he omitted Prof. Knorre's results because they were nearly identical with his own! But Dr. See's reputation as an astronomer is so good that we fear he will really have to find a better reason for rejecting observations than the mere fact of their agreement with his own. The whole thing looks like a comedy of errors to which the present note will perhaps add a final amusing scene. H. J.

The London *Times* states that the President of the Royal Astronomical Society has announced the plans of the permanent eclipse committee in view of the eclipse of the sun occurring on the 9th of August, this year, and that two new instruments to be used in observations have been shown to members of the Society. One of these, the cœlostat, suggested by M. Lippmann, in the *Comptes Rendus*, has been made on the advice of Dr. Common, who has contributed the plane mirror of the instrument. Its purpose is to deflect the rays of the object into a fixed telescope, instead of having to put the telescope itself in motion. The second instrument is a modification of the Foucault heliostat, by Captain Hills; and this, in similar manner, deflects the image rays. It is said that Dr. Common will accompany the expedition to Vadsö, and will take photographs, with a long axis mirror or lens, of the lower portion of the corona. The telescopes and the spectroscopes will be the same as formerly employed, for the sake of continuity. Two steamships will be sent from London to Vadsö on the Varanger Fiord, which will afford tourists as well as men of science a convenient opportunity to witness the eclipse.

RUSSIAN SCIENCE NEWS.

The Imperial Academy of Sciences of St. Petersburg has elected as honorary members, Hermite, Weierstrass and Pope Leo XIII; as corresponding members, Darboux, Klein, Fuchs, Jordan, Picard, Poincaré.

The academicians Sonine and Markov have commenced an edition of the collected works of Pafnooti Lvovich Chebîshev, in Russian and French. All papers written in Russian will be translated into French, and *vice versa*. A translation of the greatest work of Lobachévski, his 'New Elements of Geometry with a Complete Theory of Parallels,' is so much desired by men of science that at the Centenary Anniversary of the Institute of France Sophus Lie and Darboux addressed to the representative of the Russian Academy of Sciences the request that all the works of Lobachévski be published in French. Without waiting for the effect of this request, negotiations have been set on foot looking to the publication in Paris by Gauthier-Villars or A. Hermann, of a French translation furnished from America but edited by Professor A. Vasiliev, the great Russian authority on Lobachévski.

Vasiliev's address on Lobachévski has been reproduced in German by Prof. Friedrich Engel, of the University of Leipzig, who acknowledges his indebtedness to Halsted's English translation, reviewed in this journal March 29, 1895.

K. A. Andreyev, President of the Mathematical Society of Charkov, has issued an important monograph on Vasíli Grigorevich Imshenetzki, with a handsome portrait. It includes biography, critical estimate and bibliography. George Bruce Halsted.

GENERAL.

The names of the members of the general committee of the Huxley Memorial have now been published. The total number is about 800, of whom about 50 are Americans. We have not learned of any steps having been taken to organize an executive committee in America, and it is not clear whether intending subscribers should wait for this or should send their subscriptions to England. Donations may, however, be sent to the Treasurer, Sir J. Lubbock, or the bankers, Messrs. Robarts, Lubbock & Co. (15, Lombard Street, E. C.), or to the Honorary Secretary, Prof. G. B. Howes (Royal College of Science, South Kensington, S. W.).

The French government has voted £400 towards the fund for erecting a statue in Paris to the memory of Pasteur; the fund exceeds the expense, and the surplus is to be used for a bust of Pasteur in the Pasteur Institute. As already stated in this journal, there have also been formed committees at Chartres and Dôle for the purpose of erecting statues to the memory of Pasteur in those towns. The French Chamber of Commerce in London would be glad to receive subscriptions for the monument to be erected in Dôle, the birthplace of Pasteur. Subscriptions may be sent to the President, M. Marius Duché, Monument House, E. C.

Mr. Robert T. Hill, of the United States Geological Survey, sailed on the 18th of January upon the third of a series of geological reconnaissances of the tropical American region, which he is undertaking under the auspices of Prof. Alexander Agassiz. He will visit many points of geologic interest concerning which knowledge is much needed. The plan of these researches is to acquire accurate detailed knowledge of typical regions in order that the whole of the complicated history may be ultimately interpreted. Mr. Hill's report upon the geology of the Isthmus of Panama and adjacent regions of Costa Rica, embodying the results of last winter's investigations, is nearly completed, and will deal minutely and thoroughly with the complicated and interesting geology of the region.

DR. DAVID STARR JORDAN was elected President of the California Academy of Sciences at its recent annual meeting.

THE next annual meeting of the British Medical Association will be held in Carlisle.

THE memorial to John Rae, the Arctic explorer, which has been executed in London by Mr. Whitehead, has been placed in St. Magnus Cathedral, Kirkwall. The monument stands opposite that of Baike, the African explorer.

AT the annual meeting of the American Society of Naval Engineers, Chief Engineer E. D. Robie was elected President, and passed Assistant Engineer F. C. Bieg, Secretary and Treasurer.

Natural Science states that the Geological Survey of India has begun a folio publication entitled *Quarterly Notes*, and the Geological Survey of Mexico has begun a *Boletin de la Comision Geologica de Mexico.*

AT the annual meeting of the American Geographical Society held at Chickering Hall, New York, on January 13th, Judge Charles P. Daly was elected President. The Society has received the legacy of $100,000 bequeathed by the late General George W. Cullom, to provide for the construction of a fire-proof building.

THE latest advices from Honolulu state that after a pause of thirteen months Kilauea is in active eruption.

ACCORDING to the New York *Evening Post* preparations are in progress at Glasgow University for celebrating Lord Kelvin's fifty years' connection with that body.

THE gold medal of the Royal Astronomical Society of London has been awarded to Dr. Seth C. Chandler for his work on the variation of terrestrial latitude and variable stars.

PROF. E. RAY LANKESTER has been appointed a Vice-President of the Royal Society.

WE learn from *Nature* that the inhabitants of Zürich have rejected, by 39,476 votes to 17,297, a proposal submitted to them for the absolute prohibition of vivisection. On the other hand, a counter proposal of the Grand Council in favor of the protection of animals with due satisfaction to the demands of science was adopted by 35,191 votes to 19,551.

A CABLEGRAM to the daily papers states that Eyvind Astrup, the Norwegian explorer who was with Lieutenant Peary in Greenland, is missing. He started to make an expedition in the mountains during the Christmas holidays, and has not since been heard from. A party has been formed to go in search of him.

MESSRS. MACMILLAN & Co. have in preparation a *Dictionary of Philosophy and Psychology*, edited by Prof. J. Mark Baldwin of Princeton.

THERE will be held at Innsbrück, from May to October of the present year, an International Exhibition of Hygiene.

THE late Baron Larrey has left a bequest to the Academy of Sciences for an annual prize of $5,000 for the best treatise by an army doctor on any question of medicine, surgery or sanitation.

IT is stated that $22,500 have been subscribed towards defraying the expenses of the meeting of the British Association in Toronto in 1897: $10,000 by the Dominion government; $7,500 by the Provincial government, and $5,000 by the corporation of the city.

THE Vienna *Presse*, the London *Standard* and other daily papers report what purports to be an extraordinary discovery by Prof. Röntgen. It is claimed that he has found that the ultra violet rays from a Crookes' vacuum tube penetrate wood and other organic substances, whereas metals, bones, etc., are opaque to them. It is said that he has thus photographed the bones in the living body, which would be one of the most important advances that has ever been made in surgery. The photographs have been sent to Vienna and are in the hands of Prof. Bolzmann, who has, it is said, accepted the discovery, though he has not succeeded in his attempt to repeat the experiment. In spite of apparently absurd statements concerning the action of the ultra violet rays, it is not impossible that substances such as metals, which are good conductors of heat, should absorb the ultra violet rays, while substances such as wood, which are bad conductors of heat, should transmit them. Prof. Röntgen is professor of physics at Würzburg, and any experiments published by him would be accepted without hesitation.

WE learn from the *International Medical Magazine* that the Royal Academy of Medicine of Belgium offers prizes of 5000, 8,000 and 25,000 francs for the best researches on the diseases of the central nervous system with special reference to epilepsy. The competition closes on the 15th of September, 1899. Smaller prizes are offered in 1896 on subjects pertaining to pharmacology and the blood.

PROF. CAMILLE FLAMMARION reported to the Paris Academy on December 30th further experiments on the effects of colored glass on the growth of plants; he found the order in the development of height in sensitive plants for different glasses to be: red, green, transparent, blue. The plants grown under the transparent glass, however, surpassed in vigor those grown under the green glass. He secured similar results, but less marked, with geraniums, strawberry plants, pansies, etc. In the discussion that followed, M. Armand Gautier stated that he had found that vegetables grew well under red light, less well under yellow light, still worse under violet light and that they died under green light. He had placed pots of flowers in a current equal to that from three Bunsen cells for two and a-half months, and had found that the plants growing in the soil through which the currents passed had grown twice as as much as those placed under the same condition, but without the current.

IT is stated that it is proposed to build a railway or elevator to the summit of Mount Blanc in a manner similar to that planned for the Jungfrau. A tunnel would be built beginning at a height of 2,200 meters above the sea level and the length of the shaft would be 2,539 meters. A hotel would be built at the summit and the entire ascent would occupy only thirty minutes.

THE capital necessary for the purpose of sending an expedition to the Antarctic regions with a view to carrying on whale and sea fishing has been subscribed in London. It is proposed to send out two whaling steam vessels of 300 or 400 tons, and, we understand, also one or more of the smaller steamboats which are used by the Norwegians for the capture of the blue whale. If £5,000 can be collected to defray the expenses Mr. Borchgrevink with eight or ten companions will accompany the expedition with a view to scientific research.

IT appears that in the French expedition to Madagascar the mortality from fever amounted to 5,000 or one-fourth of all who took part in the expedition; fifty per cent. of the whole number were seriously ill, and of twenty-five per cent. remaining, scarcely any entirely escaped. Only seven men were killed in battle. In the Japanese-Chinese War 3,148 of the 200,000 Japanese soldiers engaged in the contest died as the result of disease, and 969 as the result of injury in battle.

A CORRESPONDENT of the *London Times* states that the war against rabbits in Australia seems to have had but little result. Since 1883 New South Wales, alone, has spent over $5,000,000 in the attempt to subdue or exterminate them, but apparently without effect. A reward of $125,000 has been offered by the New South Wales government for an efficient method of getting rid of the pest. The final outcome of Royal Commissions, of intercolonial conferences, and of the testing of every practical method of extermination, is that the most effectual method of dealing with the evil is found to be the construction of rabbit-proof netting, by means of which the animals can be kept from areas not yet infested; can be shut off from food supplies; and can be more effectually dealt with locally. In New South Wales alone 15,000 miles of rabbit-proof netting has been erected, but in this colony 7,000,000 acres have been abandoned largely owing to the gravity of the pest.

Natural Science has adopted with its January number the plan recently reported in this journal of underlining the most important word or words in the title of each article, and of giving at the head of the article the index number under which the article is placed in the Dewey system of classification. The index number, supposing a satisfactory system of classification can be agreed upon, would seem to satisfy the requirements of bibliographical classification. The significant word in the title is usually easy to discover, and when the title is well chosen all the words are apt to be significant. Thus the articles in the current number of *Natural Science* on 'The Endeavor After Well Being;' 'The Constantinople Earthquake of July 10, 1894,' and 'The Perth Museum of Natural History,' have all the words excepting the articles and prepositions partly or entirely underlined. It might, however, lead authors to be more careful in the choice of titles if they considered the necessity of underlining the words significant of the contents of the article.

UNIVERSITY AND EDUCATIONAL NEWS.

CONTRACTS have been awarded for the construction of the Schemmerhorn Hall of Natural Sciences and the Hall of Physics for Columbia College. The buildings will be ready for occupancy in the summer of 1897. The Trustees of Barnard College, at a meeting held on the 17th ult., accepted the plans and specifications for the proposed new building to be erected at the Boulevard and 119th street. The building is to be 200 by 160 feet, and will cost about $500,000.

THE Council of the University of the City of New York has decided to continue the summer courses inaugurated last year. The session will be held at University Heights from July 13th to August 21st. Courses will be offered in ten departments.

PROF. J. H. VAN'T HOFF, the brilliant chemist, now at Amsterdam, has resigned, probably to take a place created for him in the University of Berlin. The city of Amsterdam and the Dutch government made every effort to prevent him from leaving Holland. The authorities of the University offered to appoint an assistant professor whose duty it should be to give all the lectures and attend to all examinations. All that they required of Van't Hoff was the givin of two lectures a week. It is doubtful whether any professor has ever received a more flattering offer.

THE Boston *Transcript* states that some years ago J. H. Armstrong, of Plattsburg, deeded a considerable property to Union College, but retained a life interest in it. On January 2d of this year he died, and by his will added to the gift, which now amounts to $100,000. Mr. Armstrong was a lawyer, and it was his intention that the department of sociology should be benefited by his will.

THE Legislature of Massachusetts has passed the bill appropriating $25,000 to the Massachusetts Institute of Technology.

MRS. JOSIAH N. FISKE has given Barnard College $5,000 for the foundation of a scholarship which will be open to competition.

DISCUSSION AND CORRESPONDENCE.

MARSH GAS UNDER ICE.

AN interesting chemical experiment, quite new to me, was performed by a party of skaters in the neighborhood of Baltimore a few days ago. It is possible that it has been performed before, but I have not yet found any one who has seen or heard of it, and I therefore think it may interest the readers of SCIENCE. The skaters were on a large artificial lake upon which remarkably clear ice had formed. In various places white spots were noticed in the ice, suggesting, as one of the skaters said to me, 'air bubbles.' Some one bored a hole through one of these white places, and applied a flame to the gas, which took fire. This led to further experiments, and it was found that, by boring a small hole, a long thin jet of flame could be obtained, and this continued for some time. The gas was, of course, marsh gas, formed by the decomposition of the vegetable matter at the bottom of the lake. The above method of demonstrating the formation of this gas in nature is, from the æsthetic point of view, a great improvement on the usual method described in the text-books, which consists in stirring a pool of stagnant water with a stick, and collecting the gas that rises to the surface.

Skating ponds illuminated by natural gas are among the possibilities of the future.

IRA REMSEN.

BALTIMORE, January 14, 1896.

'PROFESSORS' GARNER AND GATES.

THE daily papers state that Mr. Richard L. Garner, whose alleged investigation of the speech of monkeys has been so prominently advertised, is again expected in America. Accounts of the alleged investigations of Mr. Elmer Gates on the development of the brain are also being extensively reported. It is perhaps the duty of a scientific journal to state that neither of these gentlemen has as yet published scientific work deserving serious consideration. J. McK. C.

SCIENTIFIC LITERATURE.

The Psychology of Number and Its Applications to Methods of Teaching Arithmetic: By JAMES A. MCLELLAN, A.M., LL.D., and JOHN DEWEY, Ph.D. International Educational Series. D. Appleton & Co., New York.

This book makes a false analysis of the number concept, but advocates methods in teaching arithmetic which are in the main good. The conviction of its authors that the difficulties which children have with arithmetic are due to the neglect of teachers to lay sufficient stress on the metrical function of number has carried them to the extreme of maintaining that number is essentially metrical in its nature and origin. The conviction is well founded, inasmuch as the first serious difficulties of children are with fractions whose primitive function was unquestionably metrical and to which men in general attach no other than a metrical meaning; but there is no reason for drawing the conclusion that because the fraction, which is but a secondary concept of arithmetic, is metrical, its primary concept, the integer, is metrical also, or even that because a child can hardly be made to understand fractions without associating them with measurement, he requires the same help with integers. Nevertheless, the authors of this book maintain, in the most unqualified manner, that the integer is essentially metrical and should be taught accordingly. Thus they account as follows for the origin of number: Man found himself in a world in which the supply of almost everything that he needed was limited. To obtain what he required, therefore, an economy of effort, a careful adjustment of means to an end, was necessary. But the process of adjusting means to an end is valuable in the degree in which it establishes an exact balance between them. "In the effort to attain such a balance, the vague quantitative ideas of smaller and greater * * * were transformed into the definite quantitative ideas of just so distant, so long * * *. This demands the introduction of the idea of number. Number is the definite measurement, the definite valuation of a quantity falling within a given limit."

They define counting, the fundamental numerical operation as but measuring with an undefined unit. "We are accustomed to distinguish counting from measuring. Nevertheless, all counting is measuring and all measuring counting. The difference is that in what is ordinarily termed counting, as distinct from measuring, we work with an undefined unit; it is vague measurement because our unit is unmeasured. * * * If I count off four books, 'book,' the unit which serves as unit of measurement, is only a *qualitative*, not a *quantitative* unit."

And they formally define number as 'the repetition of a certain magnitude used as the unit of measurement to equal or express the comparative value of a magnitude of the same kind,' a definition which, so far as it goes, agrees, it is true, with that given by Newton in his *Arithmetica Universalis*, viz, 'the abstract ratio of any quantity to another quantity of the same kind taken as unit,' though Newton's purpose having been to formulate a working definition comprehensive enough to include the irrational number, it is anything but evident that this statement represents his analysis of the notion of number in the primary sense.

The immediate objection to all this is that it is much too artificial to be sound. And in fact it requires but a little reflection to be convinced that pure number is not metrical and that counting is not measuring, but something so much simpler that men must have counted long before they knew how to measure in any proper sense.

It is not enough to say that counting is the simplest mathematical operation; it is one of the simplest of intellectual acts. For to count a group of things on the fingers is merely by assigning one of the fingers to each one of the things to form a group of fingers which stand in a relation of 'one-to-one correspondence' to the group of things. And counting with numeral words is not a whit more complex. The difference is only that words instead of fingers are attached to the things counted. But, the order of the words being invariable, the last one used in any act of counting is made to represent the result, for which it serves as well as the group of all that have been used would do. The group of fingers or this final numeral word answers as a register of the things by referring to which one may keep account of them as a child does of his marbles or pennies without remembering them individually, and this is the simplest and most immediate practical purpose that counting serves.

The number of things in any group of distinct things is simply that property of the group which the group of fingers—or, it may be, of marks or pebbles or numeral words—used in counting it represents, the one property which depends neither on the character of the things, their order nor their grouping, but solely on their distinctness. Gauss said with reason that arithmetic is the pure science *par excellence*. Even geometry and mechanics are mixed sciences in so far as their reality is conditioned by the correctness of the postulates they make regarding the external world. But the one postulate of arithmetic is that distinct things exist. It is an immediate consequence of this postulate that the result of counting a group of such things is the same whatever the arrangement or the character of the things, and this is the essence of the number-concept.

Counting, therefore, is not measuring and number is not ratio. Pure number does not belong among the metrical, but among the non-metrical mathematical concepts. The number of things in a group is not its measure, but, as Kronecker once said very happily, its 'invariant,' being for the group in relation to all transformations and substitutions what the discriminant of a quantic, say, is for the quantic in relation to linear transformations, unchangeable. Nor are the notions of numerical equality and greater and lesser inequality metrical. When we say of two groups of things that they are equal numerically, we simply mean that for each thing in the second there is one in the first and for each thing in the first there is one in the second, in other words that the groups may be brought into a relation of one-to-one correspondence, so that either one of them might be taken instead of a group of fingers to represent the other numerically. And when we say that a first group is greater numerically than a second, or that the second is less than the first, we mean that for each thing in the second there is one in the first, but not reciprocally one thing in the second for each in the first. Instead of comparing the groups directly we may count them separately on the fingers, and by a comparison of the results obtain the finger representation of the numerical excess of the one group over the other in case they are unequal. And this is all that is meant when we say that by counting we determine which of two groups is the larger and by how much.

It is therefore obvious, as for that matter our authors themselves urge, that the rational method of teaching a child the smaller numbers is by presenting to him their most complete symbols, corresponding groups of some one kind of thing as blocks, marbles or dots. By such aids he may be taught, with as great soundness as concreteness, not only the numbers themselves and their simple relations, but the meaning of addition, subtraction, multiplication and division of integers and the 'laws' which characterize these operations. This accomplished, he is ready to be taught notation and the addition and multiplication tables and to be practised on them until he has attained the art of quick and accurate reckoning. 'Measuring with undefined units' is a fiction with which there is no need to trouble him. For in however loose a sense the word may be used, 'measuring' at least involves the conscious use of a unit of reference. But no one ever did or ever will count a group of horses, for instance, by first conceiving of an artificial unit horse and then matching it with each actual horse in turn—which 'measuring' the group of horses must mean if it means anything. A conception of 'three' which makes 'three horses' mean in the last analysis 'three times a fictitious unit horse' does not differ so essentially as our authors think from the 'fixed unit' conception of this number against which they protest so strenuously. And this fictitious operation is no more the essence of multiplication and division than it is of counting. Multiplication of integers is abbreviated addition. The product 'three times two' is the sum of three two's not, happily, the measure in terms of a primary undefined unit of something whose measure in terms of a secondary undefined unit is three, when the measure of the secondary unit itself in terms of this primary unit is two.

On the other hand, measuring in the ordinary sense—the process which leads to the representation of *continuous* magnitudes as lines or surfaces, in terms of some unit of measure—deserves all the prominence which our authors would give it in arithmetic. We do not mean measuring in the exact mathematical sense, of course, but the rough measuring of common life, in which the magnitude measured and the unit are always assumed to be commensurable.

Compared with counting, or even addition and multiplication, an operation which involves the use of an arbitrary unit, and the comparison of magnitudes by its aid, is artificial. But this metrical use of number is of immense practical importance and of great interest to any child mature enough to understand it. No doubt a child may use a twelve-inch rule to advantage when practicing multiplication and division of integers. Certainly such an aid is almost indispensable in learning fractions. Without it the fraction is more than likely to be a mere symbol to him, without exact meaning of any kind. 'Two-thirds' has a reality for the child who can interpret it as the measure of a line two inches long in terms of a unit three inches long, which it quite lacks for him who can only repeat that it is 'two times the third part of unity.' Mathematicians now define the fraction as the symbolic result of a division which cannot be actually effected, but that definition will not serve the purposes of elementary instruction. It is as certain that the fraction had a metrical origin as it is that the integer had not, and in learning fractions, as in learning integers, the child cannot do better than follow the experience of the race.

Our authors must, therefore, be credited with doing the cause of rational instruction in arithmetic a real service by laying the stress they do on this proper metrical use of number. Their chapters on the practical teaching of arithmetic, moreover, though unduly prolix, contain many excellent suggestions. It is a pity that a book in the main so sound in respect to practice should be wrong on fundamental points of theory. One can but regret that its authors did not take pains before writing it to read what mathematicians of the present century have had to say on the questions with which they meant to deal. Their conception of number might have been modified by the considerations which have led mathematicians to 'arithmetise' the higher analysis itself by replacing the original metrical definition of the irrational number by a purely arithmetical one. At all events their notions of certain mathematical concepts would not have been so crude; they would not have made such a use of mathematical terms as this: "Quantity, the unity measured, whether a 'collection of objects' or a physical whole, is *continuous*, an undefined how *much;* number as measuring value is discrete, how *many.*"

H. B. Fine.

Princeton, December 31, 1895.

Experimental Farms. Reports for 1894. Printed by order of Parliament. Ottawa, 1895. 422 pp. 8°.

The direct application of scientific methods of investigation to practical questions has, perhaps, in no field found greater extension during the last decade on this continent than in agriculture. The establishment of the experiment stations in connection with agricultural colleges in all our States by the Hatch Act of 1887 has revolutionized the possibilities of agricultural pursuits, and what this act did for the United States, Canada did the same year in perhaps a more efficient if not as extensive manner for its people. This greater efficiency we would attribute to the fact that the direction of the five experimental farms located in different parts of the country is concentrated in one director and one staff, thereby producing that unity of purpose which insures success.

There is considerable scientific interest in the present (8th) annual report, issued under the editorship of the able director, Prof. Wm. Saunders, who is acknowledged as ideally fitted for his position.

We can only refer to a few of the most interesting results reported:

Prof. Jas. W. Robertson, the agriculturist, gives an outline of comparative tests of pure cultures of bacteria in the ripening of cream, from which he deduces results of a most interesting nature, showing the practical application of science in butter making. It was found that the flavor of butter is largely determined by the bacteria which develop in milk and cream, and that the conditions favoring the most satisfactory development of such bacteria prevail in a perfectly clean, well ventilated dairy; the bacteria present in the atmosphere under such conditions being superior to any artificial cultures tested.

The Chemist, Prof. Frank T. Shutt, contributes a notable article on the chemistry of the apple, completing the record of an investigation begun in previous years. It appears from the tables accompanying this discussion that 1,000 pounds of the leaves of the apple contain, as an average of the results of analyses of four varieties, 7.42 pounds nitrogen, 2.45 pounds phosphoric acid and 2.52 pounds of potash, most of which is of course returned to the soil. Estimating the average crop of the four varieties analyzed at 160 barrels per acre, there is removed from each acre in every crop of fruit the following quantities of important fertilizing constituents: 8.952 pounds nitrogen, 5.228 pounds phosphoric acid, 32.808 pounds potash. The chemist then advises the turning under of a leguminous crop, wood ashes and barnyard manure as a means of restoring to the soil the elements removed in the fruit crop.

There is no unnecessary use of technical terms in this admirable paper, and the deductions are drawn so directly from laboratory results that the veriest tyro cannot fail to be impressed with the close relation of this science to agriculture. The chemistry of the strawberry plant and of copper-salt fungicides is also discussed.

The reports of the horticulturist, the entomologist and the poultry manager are of the same high order of practically applied science.

B. E. FERNOW.

Les Nouvelles Théories Chimiques. Par A. ÉTARD, Paris, G. Masson, et Gauthiers-Villars et fils. 12 mo., pp. 196.

This volume is one of a series, Encyclopédie Scientifique des Aide-Memoire, published under direction of M. Léauté, Membre de l' Institut.

The author aims to present, in brief outline, the principal chemical theories of the day. His book is divided into two parts. Part I. consists of three sections, containing in all six chapters. These are devoted to: Definitions and general principles; a discussion of the atomic and kinetic hypotheses; a consideration of the chemical properties of molecules dependent upon the three states of aggregation of matter—the solid, the liquid, the gaseous.

Part II. contains four chapters. The first of these refers to the relation between mechanics and chemistry; the others treat respectively of thermo-, photo- and electro-chemistry.

Concerning the nature of matter the author refers to the views held by some 'Dynamistes purs,' that matter has no actual existence, but that that which we term matter is rather a sort of illusion of our senses impressed by a group of factors depending on energy, space and time.

Matter, he says, can not be precisely defined; it is everything which has weight, which can be seen or felt. Chemistry is described as the science of the transformations experienced by matter.

It will be of interest to many to learn (p. 46) that A. E. Béguyer de Chancourtois in his Vis tellurique, classement des corps simples ou radicaux obtenu au moyen d'un système de classification hélicoïdal et numerique, Paris, 1863, is credited with being the first to have published a continuous classification of the elements arranged according to their atomic weights. It will be recalled that Newlands' first communication 'On Relations Among the Equivalents,' appeared in the Chemical News, February 7th, of the year mentioned.

Attention is also called to the various shortcomings of the Periodic Law, and the surmise is hazarded that perhaps some day this system of classifying the elements may be abandoned and recourse again had to Dumas' system of grouping the elements in natural families—of course, with modifications suggested by recent advances in chemistry.

In discussing the ion theory of Arrhenius, the author declares the idea of ion movements in fluids to be but a form of the kinetic hypothesis, advanced by Bernouilli about the middle of the last century; the ion playing the part of the gaseous molecule.

The attempt to cover so wide a range in so narrow a compass as Étard has chosen has, of course, necessitated an exceedingly terse mode of treatment. Although exception may be taken to some minor points, the author is evidently thoroughly abreast of the times, and has certainly succeeded in presenting the essential features of the numerous and varied themes he considers clearly and concisely.

FERDINAND G. WEICHMANN.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JANUARY.

On the constitution of Phenoquinone: By C. LORING JACKSON and GEO. OENSLAGER. As a result of their work on the hemiacetals, compounds of the phenoquinone group, the authors suggest structural formulæ for phenoquinone and quinhydrone. They have determined the structure of the hemiacetals and base the present hypothesis on the great similarity between these substances and phenoquinone, the former being formed (theoretically) by the addition of two molecules of alcohol to quinone, and the latter by the addition of two molecules of phenol to quinone. They find the properties and reactions of the phenoquinone can be readily explained by this structure, and that in most cases the properties are those of the hemiacetals.

The Chemical Kinetics of Oxidation: By H. SCHLUNDT and R. B. WARDER. Warder reviews the work of a number of investigators on oxidation processes and discusses the results obtained by Schlundt, treating his curves mathematically, and drawing some general conclusions as to the theory of oxidation processes.

Composition of Ohio and Canadian Petroleums: By C. F. MABERY. The author continues the report begun in the last number of this journal. He finds that both Ohio and Canadian petroleum contain small quantities of benzol, toluol and xylols. Both these oils resemble the Russian oil more closely than they do the Pennsylvania, and the Canadian oil has a smaller quantity of substances belonging to the methane series than the Ohio oil. The author refers to the various views as to the origin of petroleum and the difficulty of obtaining evidence on this point.

This number also contains reviews of the following books: Chemical Analysis of Oils, Fats and Waxes, R. Benedikt and S. Lewkowitsch; Analytical Chemistry, N. Menschutkin; Solution and Electrolysis, W. C. D. Whetham; Grundriss der Elektrochemie, H. Jahn; Grundzüge der wissenschaftlichen Elektrochemie auf experimenteller Basis, R. Lüpke; Practical Proofs of Chemical Laws, V. Cornish.

J. ELLIOTT GILPIN.

THE MONIST, JANUARY.

PROF. MACH, in the opening article (his inaugural lecture delivered on assuming the professorship of the History and Theory of Inductive Science in Vienna) discusses the part which chance, or rather *accident*, has played in invention and discovery. He considers the general relations of science to philosophy, gives practical examples of the devious ways by which knowledge has been accumulated, and formulates the conscious and unconscious methods employed by scientific discoverers in their search for truth.

In *Pathological Pleasures and Pains* Prof. Th. Ribot applies the pathological method of amplification, as furnished by disease, to the study of abnormal pleasures, with interesting results.

Dr. Carus gives an exhaustive study of *Chinese Philosophy*, accompanied by numerous tables, diagrams and ideographic characters. He has interspersed his discussions with sufficient history to make the science and philosophy of the Chinese intelligible, and to exhibit the causes on which their intellectual stagnancy rests. He has considered thoroughly the Chinese theory of permutations (a theory of philosophy which is mathematical in its character), their supposed employment of the binary system of numeration, their cosmology, ontology, their ethics and religion.

In a long article Prof. August Weismann expounds and defends his new theory of *Germinal Selection*, a modification of Wilhelm Roux's idea of the principle of selection as applied to the *parts* of organisms—the struggle of the parts. Weismann reviews the *whole* status of the problem of the efficacy of natural selection, attacks the doctrines of internal formative laws and of internal motive forces in evolution, ascribing all impulse and guidance in the choice of variations to utility. Establishing the efficacy of selection by what he deems indisputable evidence, he contends, nevertheless, that natural selection does not explain a very important *crux* of evolution, viz, why the useful variations are always present. Something is wanting to the selection of *persons*, and that missing agency is supplied by *germinal* selection, which the author claims is the last consequence of the application of the principle of Malthus to living nature, and has its roots 'in the necessity of putting something else in the place of the Lamarckian principle,' which is declared to be inadequate. His treatment of the views of American inquirers on this point shows a higher appreciation of the strength of their position than we are accustomed to expect from European critics. In opposition thereto, however, he maintains—and here the whole burden of his objection rests—that since degeneration takes place in superfluous parts having only *passive* and not active functions, as in the chitinous parts of the skeleton of Arthropoda, therefore, it is certain that the cessation of functional action is not the efficient cause of degeneration. It is a curious and instructive circumstance that he grounds his arguments upon the same facts as his opponents, viz., on the facts of artificial selection. He repudiates the charge that his germ elements are modernized reproductions of Bonnet's preformations, and also argues for the simplicity of his theory of the constitution of the germinal substance as compared with that of Spencer. The mechanism of the selection and survival of the plus and minus determinants in Weismann's theory of the *germinal* battle for life is that of oscillations of the nutrient supply and of the *active* as well as passive assimilative powers of the struggling particles.

In the last article, *On the Nature of Mathematical Knowledge*, Prof. H. Schubert, of Hamburg, shows the varying degrees of certainty attainable in the different branches of mathematics as compared with each other and with the remaining sciences, and points out the leading features by which mathematical thought is distinguished from other rational processes.

Prof. Henry F. Osborn reviews the late Mr. Romanes's *Post-Darwinian Questions*. Other important works in science and philosophy also receive critical discussion.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON. 253D MEETING, SATURDAY, JANUARY 11.

GERRIT S. MILLER read by title a paper on *the Sub-genera of voles* (*Microtinæ*).

T. S. Palmer spoke on *Rabbit Drives in the West*, illustrating his remarks with lantern slides. He alluded to the great destruction caused by the introduction of rabbits into New Zealand and Australia, and the efforts to check their increase, and described the damage to fruit and other crops in California. The drives were undertaken with the object of reducing the numbers of the rabbits and the principal locality where they were held was in the San Joaquin valley. The method was practiced on a limited scale by the Indians as far back as 1839, but the first of the modern drives by whites took place at Pixley, Cal., in November, 1887. The principle of a drive was as follows: A corral or pen of some kind was built with wing fences leading from it for a long distance, like a funnel, and a multitude of people, who assemble in response to notices and advertisements form a line and drive the rabbits toward this trap. The line may be several miles in length and it is formed some distance from the pen. The rabbits which try to double on the line are killed with clubs, and when the others have been driven into the trap, gates are shut and all clubbed to death. The number destroyed in 208 drives, including under this head the 'shotgun hunts' of Colorado and Utah, was 459,000, the average per drive being about 2,200; the greatest number killed at any one time was in March, 1892, at Fresno, Cal., when 8,000 people participated and 20,000 rabbits were taken.

Rabbit driving has declined in the San Joaquin Valley during the last three years, but is now being actively prosecuted in northeastern California and in certain parts of Oregon and Idaho, while thousands of rabbits are killed annually in the Colorado and Utah hunts. Drives can only be used in the case of Jack-rabbits, which do not burrow, but under favorable circumstances afford a most efficient means of keeping the animals in check.

Dr. V. A. Moore read a paper on *The Nature of the Flagella of Motile Bacteria with special reference to their value in differentiating species.*

The paper was a summary of the present knowledge of the nature and significance of the flagella, or organs of locomotion, of motile bacteria. A method seems not to have yet been formulated whereby uniform results can be obtained by different investigators. This fact renders the assertions of a few writers that the flagella are of specific diagnostic value somewhat questionable. The test of the differential importance of these filaments was applied to *Baccillus coli communis, B. typhosis and B. choleræ suis*, three species of bacteria closely related morphologically, but readily differentiated by means of physiological properties and their pathogenesis. The differences in the flagella of each of these species as found by different observers are as great as those found between the different species. The same is true of the Spirilla. The proposed classification of bacteria by Messea was shown by illustration to be of secondary importance, and the statements heretofore made concerning the specific value of the flagella were shown to be unreliable. The author favored the disposition of the flagella, as polar or diffuse, made by A. Fisher, who includes them in the characters of his subfamilies.

F. A. Lucas,
Secretary.

NATIONAL GEOGRAPHIC SOCIETY.

At the regular Friday evening meeting of the National Geographic Society held in Washington, D. C., January 10, Mr. Wm. Ellery Curtiss, of Washington, delivered a lecture, illustrated by lantern slides, on Venezuela; her government, people and boundary. The lecturer, who was formerly Chief of the Bureau of American Republics, discussed the form of government and institutions of the country and the character, manners and customs of the people. He dwelt particularly, however, on the boundary question, in certain of its phases, and set forth both the British and American contentions in the pending dispute.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the fortieth meeting of the Society, on January 9th, the first paper read was by Mr. R. T. Hill, of the U. S. Geological Survey, *On the Agassiz Expedition to Panama and Costa Rica.*

Mr. Hill gave results and methods of studies of the geological structure, paleontology and geomorphology of the Isthmus of Panama, based upon observations made by him last year, when, under a furlough from the Survey, he spent several months in the work, under the auspices of Prof. Alexander Agassiz. Mr. Hill supplemented his remarks by calling attention to the great work Prof. Agassiz is doing for science in working out the geology of Tropical America, a region having the greatest bearing upon the interpretation of our whole continental history.

The speaker made acknowledgment to the following specialists who had determined for him the many different types of material entering into this complicated section: To Dr. Wm. H. Dall, of the Geological Survey, for a report upon the Tertiary mollusca; to Prof. R. M. Bagg, of Johns Hopkins University, for interesting determinations of the Tertiary Foraminifera; to Prof. J. E. Wolff, of Cambridge, to whom the petrographic specimens were assigned; to Mr. H. W. Turner, of the Geological Survey, for minute examination of certain important and apparently indeterminate earths; to Mr. Ahe̊ Sjogren, of Stockholm, Sweden, late of Costa Rica, for carefully prepared sections and collections; and to Mr. T. Wayland Vaughan, of the U. S. Geological Survey, for determination of the fossil corals. The reports of these specialists, together with Mr. Hill's discussion of the structure, history, and physical geography, have been prepared and are nearly ready for publication.

Three geologic sections of the Central American region were presented by the speaker. The first of these was across the continent along the line of the Panama Canal and Railway. This consists of a complicated plexus of marine sedimentaries (Eocene and Miocene Tertiaries) igneous rocks (basalts, augite porphyrites, augite andesite, trachitic tufa, rhyolitic tufa and other species) and ancient detritial formations, so concealed by dense vegetation and soil (the subaereal decay, which reaches to 100 feet or more in depth,) and confused by structural disturbance that its history is most difficult to interpret. Another section was given across the Republic of Costa Rica from Punta Arenas to Port Limon, showing the contrasts between the high plateau, of recent volcanic activity and the older phenomena of Panama. The third section was from the Caribbean coast to the high mountain summits in southern Costa Rica. It is impossible to give here the great amount of detail which these sections throw upon the petrography, paleontology, orogeny and geomorphology of this exceedingly interesting region, and present for the first time any comprehensive detail by which its history may be discussed.

The discussion of the time of the union of the continents was intentionally deferred to the final report, owing to the fact that it is so involved in hypothetical discussion by naturalists that the subject requires separate treatment. "The Isthmus," said the speaker, "entirely aside from this question of the union of the oceans, is of the greatest geologic interest."

For the information of the Department of the Interior, and under special instructions from the Secretary, Mr. George H. Eldridge has just made an investigation of the principal mineral resources of the Uncompahgre Indian Reservation in northeastern Utah, and has submitted his report through the director of the Geological Survey. Mr. Eldridge contributed an interesting account of Uintaite, or Gilsonite, the principal resource found and investigated. His paper will be printed in this journal.

Prof. Chas. D. Walcott entertained the Society briefly with the presentation and informal discussion of two series of lantern-slide views. The larger series represented some recent and ancient markings on the sea shore, and showed the results of experiments and observations made by him quite recently on the beach at Noyes Point, Rhode Island, and on the Florida coast. The observations, while of interest in other respects, were presented more particularly as illustrating some supposed errors in the interpretation that observers have placed upon certain sea-shore markings. He illustrated among other things an excellent cast of a medusa, or jelly fish, one of several of which casts he had succeeded in making in plaster of paris while on the Florida coast. The other slides represented the mode of formation of sand dunes, as observed on the Rhode Island coast.

W. F. MORSELL.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 242 meeting of the Society was held on January 7. A paper on 'A Vigil of the Gods,' was read by Dr. Washington Matthews, U. S. A., of which the following is an abstract:

The rites occur on the fourth night of a great nine-days' ceremony of the Navahoes called the night-chant, which is based on a myth, and many of the acts are illustrative of the mythic events.

The night from about 9 P. M. until daylight is devoted to a vigil analogous to that of the mediæval knight over his armor. Men and gods, or the properties which represent the gods, alike participate in the vigil and there is a feast in common, or love-feast, closely resembling certain ceremonial acts observed among our own people to-day.

Although there are interesting rites, the night is spent mostly in song, and many long prayers are repeated. The songs and prayers are carefully formulated ritualistic compositions.

The masks of twenty-one gods and goddesses of the Navaho pantheon, along with other sacred properties, are spread on a buffalo robe in an established order and frequent sacrifices of pollen are made to them.

Early in the night dishes of wild herbs and seeds, such as formed the food of the Navahoes in the old days, before they became farmers and herders, are brought in, sung over and eaten by those who choose to partake.

The love-feast comes later. This consists of cold cornmeal gruel, or thin mush, prepared in a water-tight wicker bowl with many ceremonial observances. The bowl is passed around sunwise and everybody helps himself with his fingers to four morsels. But before the men partake, the gods are fed—a morsel of gruel is laid on the mouth of each mask. After the gruel is finished all partake of pollen.

About midnight the ceremony of waking the gods begins. Although the Navahoes do not use time-pieces, this act occurs always almost exactly at midnight. The shaman sings a long song, the burden of which is Hyideznâ (he stirs, he moves); a different god is mentioned in each stanza. When the singer mentions the name of a god he lifts the appropriate mask and shakes it in tune to the song. The last prayer occurs after dawn, the vigil ends, and the lodge is prepared for the work of the fifth day.

The paper closed by giving the reasons for certain Navaho symbolisms, especially that which assigns the north to the male and the south to the female.

The closing paper on *Racial Anatomical Peculiarities* was read by Dr. D. K. Shute.

George R. Stetson,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES.

In the absence of the President the meeting was called to order by Prof. R. S. Woodward. The minutes were read and approved and Dr. Franz Boas, of the American Museum of Natural History was elected resident member. Twenty-six members and guests were present. Prof. M. I. Pupin then read before the Section of Astronomy and Physics a paper on the *Magnetic circuit*. In transformers, especially of closed iron core, it has long been known that the upper 'harmonics' of the fundamental rate of alternations present in the primary are choked out by the transformer leaving the potential difference of the secondary coil represented by a simple sine curve. The choking out is less if the magnetic circuit is incomplete, and least when the coils have no magnetic core. Various explanations have been offered to account for this phenomenon; it is doubtless true that it is due to Foucault currents and to hysteresis. Dr. Pupin pointed out from certain mathematical considerations that by appropriate measurements, especially of the angle of lag, it would be possible to separate the energy consumed in Foucault currents from that consumed by hysteresis, and thus be able to study this latter puzzling phenomenon. Investigations are in progress to test the method experimentally. Prof. Crocker remarked upon the interest and importance of the questions involved.

The second paper was by Dr. A. A. Julien upon 'The condensed gas film on the surface of solid bodies with relation to (1) Newton's rings of the first order; (2) sand flotation; (3) sand in harmonic vibration.

Owing to the lateness of the hour Dr. Julien passed over the first two heads, giving an outline of the literature of the question of liquid films on solids. He then outlined his experiments in sonorizing sands artificially, and demonstrating the necessity of an antecedent water film before the sand becomes sonorous. It must also be of approximately uniform size of grain. The paper was discussed by Profs. Mayer, Van Nardroff, Pupin and Hallock. At 10:30 the meeting adjourned.

W. Hallock,
Secretary of Section.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, DECEMBER 17, 1895.

The Geology of the Woonsocket Basin. (Preliminary Report.) By F. C. Schrader.

The basin consists of a local widening in the normally trenchant valley of the Blackstone River where the river traverses a narrow belt of soft rocks. The outline of the basin is roughly that of the cross-section of a plano-convex lens, whose straight edge, representing the southeast side of the basin, extends from Primrose, south of Woonsocket Hill, in Rhode Island, ten miles northeastward to South Bellingham, in Massachusetts. The convex edge includes near its middle point Blackstone village on the northwest, whence the Blackstone river, like a vertical let fall to the opposite side just below the city of Woonsocket, bisects the basin, whose width is here about three miles.

The rocks in the basin are eroded to a depth of two hundred or more feet below the upland or old baselevel of the surrounding country. Some bed-rock hills are, however, still prominent within the basin, and the deposits of glacial drift, chiefly water-laid, frequently approach a hundred feet in thickness.

The rocks enclosing the basin are mainly gneisses, hornblende granites, and, on the west, some quartzites. Excepting a few of the granites, they are all Pre-Carboniferous and extend over wide areas of country. They have a southeast-northwest trend, and the gneisses and quartzites dip to the northeast, as seen in the Manville section and at Woonsocket Hill. Compared to the rocks within the basin, they are hard and form good resisters to weathering. To this difference of resistance to weathering between the extra- and the intra-basin rocks, the basin doubtless mainly owes its present topography.

The rocks within the basin are soft, have a southwest-northeast trend, and dip northwest. They are much younger than the enclosing rocks, with which they exhibit marked unconformities, as with the quartzites on the west and the gneisses on the north. The lowest and apparently oldest of these rocks, but of unknown age, is a uniformly very fine grained, grey, talcose, silicious mica-schist, which in the past has been worked with profit in the whetstone industry. It occurs chiefly in the southeast side of the basin. Above this grey rock, but unconformable with it, in the west part of the basin, is found a shiny black hornblende mica-schist, also of questionable age; while unconformably over both the grey and the black lie the youngest rocks in the basin. These latter, though as yet they have yielded no fossils, are probably Carboniferous, judging from their geological relations and lithologic resemblance to the well-known Carboniferous on the east, in the Narragansett Basin. They consist of grey conglomerates with interbedded mica-schists, sandstones and slates. They are derived chiefly from the surrounding older rocks of the upland, as is manifest by the granite and quartzite pebbles contained in the conglomerates, occurring east of Forestdale and at Woonsocket Hill.

Cutting the rocks in the basin at intervals is a series of diabase dikes. They range from less than one to more than a hundred feet in width, dip about vertical, and run nearly parallel, bearing north-northeast.

Preliminary Report on the Stamford Gneiss: By W. H. SNYDER.

In the southwestern part of Vermont and extending into the northwestern part of Massachusetts there occurs a coarse banded gneiss covering about 50 square miles and called by the U. S. Geological Survey the Stamford Gneiss. It was known in Pres. Hitchcock's survey of Vermont as the Stamford Granite.

This gneiss is surrounded on the east and south by a metamorphosed conglomerate, the pebbles of which correspond to the blue quartz of the gneiss. At a short distance from the contact the conglomerate changes into a micaceous quartzite. In this quartzite there has been found by Walcott trilobites which prove it to be Cambrian. On the west the gneiss appears to be bounded by a very massive white quartzite, the dip and strike of which mostly correspond to that of the micaceous quartzite on the east. The northern boundary is as yet undetermined.

At the contact of the conglomerate and gneiss there is developed between the two a layer of about a foot in thickness in which the gneissic structure is particularly pronounced, the mica making lenticular folds around the quartz grains and giving the mass the appearance of augen-gneiss. Prof. Pumpelly has suggested that this layer is the disintegrated border of the gneiss upon which the conglomerate was laid down and which has since been metamorphosed.

The gneiss itself is composed of coarse feldspar crystals, irregular masses of blue quartz and thin layers of a greenish mica. In some parts there are large Carlsbad twins of microcline and in others rounded masses of feldspar 3 and 4 inches in diameter. At one point the weathering has developed nodular feldspar aggregates as large as a hen's egg, which give the face of the ledge a conglomeratic appearance. The rocks yield easily to weathering throughout the area. There are no glacial striæ apparent upon any exposed surface.

Near the western border of the gneiss there is an outcrop of a fine grained greenish gneiss very distinct from that of the main mass and surrounded on three sides by this mass. The fourth side is hidden by a bog. The Stamford gneiss apparently overlies this gneiss and sends apophyses into it. The contact between the two is distinctly marked, and although a careful microscopical examination has not as yet been made, it does not appear to be a metamorphic contact due to stretching, but an igneous contact, the Stamford gneiss having covered, when in a melted condition, the green gneiss. The Stamford gneiss is apparently a granite which has had the gneissic character impressed upon it.

The general occurrence, composition and structure of the Stamford gneiss corresponds very closely with the Rapakiwi granite of Finnland, described by J. J. Sederholm in Tschermak's Mineralogische und Petrographische Mittheilungen, Band XII., pages 1–31, 1891. Ueber die Finnländischen Rapakiwigesteine.

DECEMBER 10, 1895.

Preliminary Notes on the North Jersey Coast. J. Edmund Woodman.

Three important causes of change are now in operation here—submergence, recession and advance. The first is widespread, but immeasurable. The evidence relevant to this is varied, but chiefly the presence of stumps in salt and brackish water. Deepening of inlets affords no criterion.

Recession is effected by (1) waves, and (2) currents. On Sandy Hook and south of Manasquan inlet this is replaced by advance or grade; hence these are nodal points. This recession is measurable, and may be prophesied approximately for any specified time within certain limits. It can be temporarily prevented at isolated points, although not by present methods, but its ultimate conquest is sure.

The waves act (1) by eroding the shore; (2) by damming inlets, and (3) by transporting material off shore to form bars. Erosion is irregular, and in places erosion and advance alternate and partially compensate. Cutting is greatest with a northeast wind—*i. e.*, when wind and current are in opposition; it is least with a southeast wind. This is contrary to general theory, but is readily explainable. The damming of inlets is caused partly by coastwise bars raised by the waves and partly by sediment from the streams falling in the dead water where current and waves meet. Probably the former cause does not operate until some sedimentation has taken place. Most of the sand eroded from the shore is carried a few hundred feet out to form bars, little migrating along the margin of the land.

The currents act (1) by carrying a small amount of sand along shore as mentioned; (2) by the migration of bars northward—the most important method of transportation, and, as a result, (3) by deposition of most or all the sand on Sandy Hook. T. A. Jaggar, Jr.,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of January 6, 1896, President Green in the chair and eighteen other members present, the officers placed in nomination at the last meeting were declared as elected for the year 1896.

The reports for 1895 of the Treasurer and Librarian were read and accepted.

Prof. Engler pointed out a simple graphical method of drawing a normal to a parabola from a point outside the curve.

On motion of Prof. Pritchett, the Council was requested to arrange for a meeting of the Academy, in the near future, commemorative of the service of four distinguished men who had died in the past year: Dana, Helmholtz, Huxley and Pasteur.

Mr. Espenschied exhibited several samples of sisal and palm-fibre utensils obtained from the Bermudas and West Indies, explaining the mode of preparation.

Two new resident members were elected.

Wm. Trelease,
Recording Secretary.

NEW BOOKS.

Movement. E. J. Marey. New York, D. Appleton & Co. 1895. Pp. xv + 318. $1.75.

Computation Rules and Logarithms. Silas W. Holman. New York and London, Macmillan & Co. 1896. Pp. xlv + 73. $1.00.

Plant Breeding. L. H. Bailey. New York and London, Macmillan & Co. 1895. Pp. vii + 293. $1.00.

The Chemistry of Pottery. Karl Langenbeck. Chemical Publishing Co., Easton, Pa. Pp. vi + 197.

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THE SMITHSONIAN INSTITUTION.

The annual meeting of the Board of Regents of the Smithsonian Institution was held Wednesday, January 22d, at 10 o'clock.

The Vice-President, Hon. Melville W. Fuller, Chief Justice of the United States, Postmaster General Wilson, Senator Justin S. Morrill, Senator Shelby M. Cullom, Senator George Gray, Representative Joseph Wheeler, Representative R. R. Hitt, Representative Robert Adams, Jr., Dr. A. D. White, General J. B. Henderson and Hon. Gardiner G. Hubbard.

The death of Doctor Henry Coppee, President of Lehigh University, long a member of the Board, was announced and appropriate resolutions adopted.

An Executive Committee was appointed as follows: Hon. John B. Henderson, Chairman; Hon. William L. Wilson and Hon. Gardiner G. Hubbard.

Secretary Langley presented his annual report, in which the chief events of importance during the past year were discussed. Allusion was made to the conferring of the Hodgkins Fund prize of $10,000, and to the transmission of the amount of the award through the American embassy in London to Lord Rayleigh and Professor Ramsay; also to the fact that a similar prize for the same discovery has recently been given to the same persons by the Institute of France. The prize of $1,000 was given to M. de Varigny, of Paris, for the best popular treatise in accordance with the terms of the announcement, and three silver and six bronze medals awarded to the laureates out of nearly 200 contestants. The medals which have been designed by Mons. T. C. Chaplain, a member of the French Institute and the most famous medalist in the world, are being struck at the government mint in Paris and will soon be ready for distribution.

The Secretary expressed the opinion that the giving of a large prize having served its purpose in attracting the attention of the world to the Hodgkins Fund and the purposes of its founder, it would probably not be wise to offer at present additional large prizes of this kind, since these have rarely been found efficacious in stimulating discovery; and that hereafter the income should be spent directly in aid of investigations in regard to the atmosphere and its properties.

Speaking of the Hodgkins bequest, Secretary Langley dwelt upon the idea that the foresight of Mr. Hodgkins has been in one particular remarkably justified, since the experience of the last three years has shown that there is no department in the field of human thought, apart from such abstract ones as æsthetics, higher mathematics, logic and the like, which does not come under the purview of this donation; so that the restriction of the income from this $100,000 of the bequest to the special purpose of investigations regarding atmospheric air is in reality no embarrasment or limitation of the free activities of the Institution.

Attention was also directed to the recent bequest of Mr. Robert Stanton Avery, of Washington, the value of which has been estimated at $50,000, but which it seems probable will not prove to be nearly so large.

The present year, 1896, being the fiftieth since the foundation of the Institution, the occasion will be celebrated by the erection of bronze tablets to the memory of the founder, James Smithson, upon his tomb in the English cemetery in Genoa, and also in the English church in the same city. A preliminary design of this tablet by Mr. William Ordway Partridge was submitted for inspection.

There will also be published a semi-centennial volume, giving an account of the origin of the Institution and summing up the results of its fifty years' activities in every department of science. This volume will be handsomely printed, in an edition sufficiently large to supply all the principal libraries of the world; and will contain portraits of the founder; the Chancellors—George M. Dallas, Millard Fillmore, Roger B. Taney, Salmon P. Chase, Morrison R. Waite and Melville W. Fuller; and those of the regents who have contributed most materially to the development and influence of the Institution, such as James A. Pierce, Alexander Dallas Bache, Louis Agassiz and George Bancroft. Chapters will be contributed by a considerable number of the most prominent scientific men and educators of the United States.

Allusion was made by the Secretary to the table at the Zoölogical Station at Naples, rented by the Institution for the benefit of investigators and students of American natural history, and to the fact that the popularity of this undertaking is so great that petitions from eight of the principal natural history societies of the country, four of them national, including together some 3,000 members, and a petition signed by 200 of the principal naturalists of the country, have been received, urging their continuance of the table for another period of three years.

The Secretary also called attention to the crowded condition of the National Museum and the necessity of new buildings, not only for the exhibition of collections, but for the storage of material now placed in temporary sheds near the building of the Institution, which, being inflammable, are a constant menace to its safety.

The Bureau of Ethnology is continuing its important work in the study of linguistics, habits and customs of the American aborigines, and important explorations have been made during the year under the direction of Mr. McGee among the Seri and Papago Indians, of the far Southwest, and by Dr. J. Walter Fewkes in the ruins of a town near Moqui, which was destroyed by hostile Indians before the first visit of the Spaniards. The latter exploration was the first ever made of a thoroughly pre-Columbian town site, and resulted in the gathering of a collection of pottery and other objects of unequalled beauty and value.

Referring to the Zoölogical Park, Secretary Langley directed attention to the alarming reports which are coming from the Yellowstone National Park, which seem to make it certain that the herd of several hundred buffalo reported last year has been reduced to fifty or less, and indicating that it will soon be destroyed unless steps are taken for its preservation. Since the means at the disposal of the custodians of the Yellowstone National Park seem quite inadequate to protect them, the desirability is suggested of transferring most of the remnant of the herd to Washington, to be placed in the Zoölogical Park, which has amply sufficient space for all that are left.

The work of the Astro-Physical Observatory was referred to, and the researches there being carried on, which are giving us a knowledge of nearly thrice the amount of details of solar energy that were known to Sir Isaac Newton, and in a region which was left almost untouched until our own day when these researches took it up. The number of known lines in this portion of the spectrum has increased from less than twenty to over a thousand owing to the work which has been carried on in this little observatory during the last four years. The location is a very unfortunate one, however, since the traffic of the street interferes with the proper use of the instruments, and reference was made by the Secretary to a plan for constructing a modest building for this work in some portion of the suburbs where the necessary quiet can be obtained.

The Secretary's report was accepted, as was also that of the Executive Committee.

Letters of acknowledgment were read from the Royal Institute of Great Britain for a portrait of Mr. Hodgkins sent by the Institution, and from the master of Pembroke College in Oxford, where Smithson received his degree in 1786, acknowledging the gift of a complete series of the publications of the Institution.

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*MEMORIAL TRIBUTE TO PROFESSOR THOMAS H. HUXLEY.**

ALL the members of this Academy, in fact all men of science in America, are in different ways indebted to the late Professor Huxley. We should be ungrateful, indeed, especially in this section of the Academy, if we failed to join in the tributes which are being paid to him in different parts of the world.

In his memory I do not offer a formal address this evening, but, as one of his students, would present some personal reminiscences of his characteristics as a teacher, and some of the striking features of his life and work.

Huxley was born in 1825. Like Goethe, he inherited from his mother his brilliantly alert powers of thought, and from his father his courage and tenacity of purpose, a combination of qualities which especially fitted him for the period in which he was to live. There is nothing striking recorded about his boyhood as a naturalist. He preferred engineering, but was led into medicine.

* Read before the Biological Section of the New York Academy of Sciences, November 11, 1895.

At the close of his medical course he secured a navy medical post upon the 'Rattlesnake.' This brought with it, as to Darwin, the training of a four-years' voyage to the South Seas off eastern Australia and west Guinea—a more liberal education to a naturalist than any university affords, even at the present day. This voyage began at twenty-one, and he says of it: "But, apart from experience of this kind and the opportunity offorded for scientific work to me, personally, the cruise was extremely valuable. It was good for me to live under sharp discipline, to be down on the realities of existence by living on bare necessities, to find out how extremely worth living life seemed to be, when one woke from a night's rest on a soft plank, with the sky for a canopy and cocoa and weevily biscuit the sole prospect for breakfast, and more especially to learn to work for what I got for myself out of it. My brother officers were as good as sailors ought to be and generally are, but naturally they neither knew nor cared anything about my pursuits, nor understood why I should be so zealous in the pursuit of the objects which my friends, the middies, christened 'Buffons,' after the title conspicuous on a volume of the '*Suites a Buffon*,' which stood in a prominent place on my shelf in the chart room."

As the result of this voyage of four years numerous papers were sent home to the Linnæan Society of London, but few were published; upon his return his first great work, *Upon the Anatomy and Affinities of the Medusæ*, was declined for publication by the Admiralty—a fortunate circumstance, for it led to his quitting the navy for good and trusting to his own resources. Upon publication, this memoir at once established his scientific reputation at the early age of twenty-four, just as Richard Owen had won his spurs by his 'Memoir on the Pearly Nautilus.' In 1852 Huxley's preference as a biologist was to turn back to physiology, which had become the favorite study of his medical course. But his fate was to enter and become distinguished in a widely different branch, which had as little attraction for him as for most students of marine life, namely, paleontology. He says of his sudden change of base:

"At last, in 1854, on the translation of my warm friend, Edward Forbes, to Edinburgh, Sir Henry de la Beche, the Director-General of the Geological Survey, offered me the post Forbes had vacated of Paleontologist and Lecturer on Natural History. I refused the former point-blank, and accepted the latter only provisionally, telling Sir Henry that I did not care for fossils and that I should give up natural history as soon as I could get a physiological post. But I held the office for thirty-one years and a large part of my work has been paleontological."

From this time until 1885 his labors extended over the widest field of biology and of philosophy ever covered by any naturalist, with the single exception of Aristotle. In philosophy Huxley showed rare critical and historical power; he made the most exhaustive study of Hume, but his own philosophical spirit and temper was more directly the offspring of Descartes. Some subjects he mastered, others he merely touched, but every subject which he wrote about he illuminated. Huxley did not discover or first define protoplasm, but he made it known to the English-speaking world as the physical basis of life; recognizing the unity of animal and plant protoplasm. He cleared up certain problems among the *Protozoa*. In 1849 appeared his great work upon the oceanic *Hydrozoa*, and familiarity with these forms doubtless suggested the brilliant comparison of the two-layered gastrula to the adult hydrozoa. He threw light upon the Tunicata, describing the endostyle as a universal feature, but not venturing to raise the Tunicata to a separate order. He set in order the cephalopod mollusca, deriving the spiral from the straight shelled fossil forms. He contributed to the Arthropoda; his last word upon this group being his charming little volume upon the 'Crayfish,' a model of its kind. But think of the virgin field which opened up before him among the vertebrata, when in 1859 he was the first to perceive the truth of Darwin's theory of descent. Here were Cuvier's and Owen's vast researches upon living and extinct forms, a disorderly chaos of facts waiting for generalization. Huxley was the man for the time. He had already secured a thoroughly philosophical basis for his comparative osteology by studying the new embryology of Von Baer, which Richard Owen had wholly ignored. In 1858 his famous Croonian lecture on the 'Theory of the Vertebrate Skull' gave the death blow to Owen's life work upon the skull and vertebral archetype, and to the whole system of mystical and transcendental anatomy; and now Huxley set to work vigorously to build out of Owen's scattered tribes the great limbs and branches of the vertebrate tree. He set the fishes and batrachia apart as the *Icthyopsidan* branch, the reptiles and birds as the *Sauropsidan* in contrast with the *Mammalian*, which he derived from a prosauropsidan or amphibian stem, a theory which with some modification has received strong recent verification.

Prof. Owen, who had held undisputed sway in England up to 1858, fought nobly for opinions which had been idolized in the first half century, but was routed at every point. Huxley captured his last fortress, when, in his famous essay of 1865, 'Man's Place in Nature,' he undermined Owen's teaching of the separate and distinct anatomical position of Man. We can only appreciate Huxley's fighting qualities when we see how strongly Owen was intrenched at the beginning of this long battle royal; he was director of the British Museum and occupied other high posts; he had the strong moral support of the government and of the royal family, although these were weak allies in a scientific encounter.

Huxley's powers of rapid generalization of course betrayed him frequently; his *Bathybius* was a groundless and short-lived hypothesis; he went far astray in the phylogeny of the horses. But these and other errors were far less attributable to defects in his reasoning powers than to the extraordinarily high pressure under which he worked for the twenty years between 1860 and 1880, when duties upon the Educational Board, upon the Government Fisheries Commission and upon Parliamentary committees crowded upon him. He had at his command none of the resources of modern technique. He cut his own sections. I remember once seeing some of his microscopic sections. To one of our college junior students working with a Minot microtome Huxley's sections would have appeared like translucent beefsteaks—another illustration that it is not always the section which reveals the natural law, but the man who looks at the section.

Huxley was not only a master in the search for truth, but in the way in which he presented it, both in writing and in speaking. And we are assured, largely as he was gifted by nature, his beautifully lucid and interesting style was partly the result of deliberate hard work. He was not born to it; some of his early essays are rather labored; he acquired it. He was familiar with the best Greek literature and restudied the language; he pored over Milton and Carlyle and Mill; he studied the fine old English of the Bible; he took as especial models Hume and Hobbes, until finally he wrote his mother tongue as no other Englishman wrote it. Take up any one of his essays, biological, literary, philosophical, you at once see his central idea and his main purpose, although he never uses italics or spaced letters, as many of our German masters do to relieve the obscurity of their sentences. We are carried along upon the broad current of his reasoning without being confused by his abundant side illustrations. He gleaned from the literature of all time until his mind was stocked with apt similes. Who but Huxley would have selected the title 'Lay Sermons' for his first volume of addresses; or, in 1880, twenty-one years after Darwin's work appeared, would have entitled his essay upon the influence of this work: 'The Coming of Age of the Origin of Species?' Or to whom else would it have occurred to repeat over the grave of Balfour the exquisitely appropriate lines: 'For Lycidas is dead, dead ere his prime.' Who else could have inveighed thus against modern specialization: "We are in the case of Tarpeia, who opened the gates of the Roman citadel to the Sabines and was crushed by the weight of the reward bestowed upon her. It has become impossible for any man to keep pace with the progress of the whole of any important branch of science. It looks as if the scientific, like other revolutions, meant to devour its own children; as if the growth of science tended to overwhelm its votaries; as if the man of science of the future were condemned to diminish into a narrow specialist as time goes on. It appears to me that the only defense against this tendency to the degeneration of scientific workers lies in the organization and extension of scientific education in such a manner as to secure breadth of culture without superficiality; and, on the other hand, depth and precision of knowledge without narrowness."

Huxley's public addresses always gave the impression of being largely impromptu, but he once told me: "I always think out carefully every word I am going to say. There is no greater danger than the so-called *inspiration of the moment*, which leads you to say something which is not exactly true, or which you would regret afterward. I sometimes envy your countrymen their readiness and believe that a native American, if summoned out of bed at midnight, could step to his window and speak well upon any subject." I told him I feared he had been slightly misinformed; I feared that many American impromptu speeches were more distinguished by a flow of language than of ideas. But Huxley was sometimes very impressive when he did not speak. In 1879 he was strongly advocating the removal of the Royal School of Mines from crowded Jermyn street to South Kensington, a matter which is still being agitated. At a public dinner given by the alumni of the School, who were naturally attached to the old buildings, the chairman was indiscreet enough to make an attack upon the policy of removal. He was vigorously applauded, when, to every one's consternation, Huxley, who was sitting at the chairman's right, slowly rose, paused a moment, and then silently skirted the tables and walked out of the hall. A solemn pall fell over the remainder of the dinner and we were all glad to find an excuse to leave early.

In personal conversation Huxley was full of humor and greatly enjoyed stories at his own expense. Such was the following: "In my early period as a lecturer I had very little confidence in my general powers, but one thing I prided myself upon was clearness. I was once talking of the brain before a large mixed audience and soon began to feel that no one in the room understood me. Finally I saw the thoroughly interested face of a woman auditor and took consolation in delivering the remainder of the lecture directly to her. At the close, my feeling as to her interest was confirmed when she came up and asked if she might put one question upon a single point which she had not quite understood. 'Certainly,' I replied. 'Now, Professor,' she said, 'is the cerebellum inside or outside of the skull?' ". A story of his about babies is also characteristic: "When a fond mother calls upon me to admire her baby I never fail to respond, and, while cooing appropriately, I take advantage of an opportunity to gently ascertain whether the soles of its feet turn in and tend to support my theory of arboreal descent."

Huxley as a teacher can never be forgotten by any of his students. He entered his lecture room promptly as the clock was striking nine, rather quickly and with his head bent forward 'as if oppressive with its mind.' He usually glanced attention to his class of about ninety and began speaking before he reached his chair. He spoke between his lips, but with perfectly clear analysis, with thorough interest and with philosophic insight, which was far above the average of his students. He used very few charts, but handled the chalk with great skill, sketching out the anatomy of an animal as if it were a transparent object. As in Darwin's face, and as in Erasmus Darwin's or Buffon's, and many other anatomists with a strong sense of form, his eyes were heavily overhung by a projecting forehead and eyebrows and seemed at times to look inward. His lips were firm and closely set, with the expression of positiveness, and the other feature which most marked him was the very heavy mass of hair falling over his forehead, which he would frequently stroke or toss back. Occasionally he would lighten up the monotony of anatomical description by a bit of humor. I remember one instance which was probably reminiscent of his famons tilt with Bishop Wilberforce at the meeting of the British Association in 1860. Huxley was describing the mammalian heart and had just distinguished between the tricuspid valve on the right side of the heart and the bicuspid valve on the left, which you know resembles a bishop's mitre, and hence is known as the mitral valve. He said, "It is not easy to recall on which side these respective valves are found, but I recommend this rule; you can easily remember that the mitral is on the left, because a bishop is never known to be on the right."

Huxley was the father of modern laboratory instruction, but in 1879 he was so intensely engrossed with his own researches that he very seldom came through the laboratory, which was ably directed by T. Jeffrey Parker, assisted by G. B. Howes and W. Newton Parker, all of whom are now professors, Howes having succeeded to Huxley's chair. Each visit therefore inspired a certain amount of terror, which was really unwarranted, for Huxley always spoke in the kindest tones to his students, although sometimes he could not resist making fun at their expense. There was an Irish student who sat in front of me, whose anatomical drawings in water color were certainly most remarkable productions. Huxley, in turning over his drawing-book, paused at a large blur under which was carefully inscribed 'sheep's liver' and smilingly said, "I am glad to know that is a liver; it reminds me as much of Cologne cathedral in a fog as of anything I have ever seen before." Fortunately the nationality of the student enabled him to fully appreciate the humor.

The greatest event in the winter of 1879 was Darwin's first and only visit to the laboratory. They came in together, Huxley leading slowly down the long, narrow room, pointing out the especial methods of teaching, which he had originated and which are now universally adopted in England and in this country. Darwin was instantly recognized by the class as he entered and sent a thrill of curiosity down the room, for no one present had ever seen him before. There was the widest possible contrast in the two faces. Darwin's grayish-white hair and bushy eyebrows overshadowed the pair of deeply-set blue eyes, which seemed to image his wonderfully calm and deep vision of nature and at the same time to emit benevolence. Huxley's piercing black eyes and determined and resolute face were full of admiration, and, at the same time, protection of his older friend. He said afterwards, "you know I have to take care of him, in fact, I have always been Darwin's bulldog," and this exactly expressed one of the many relations which existed so long between the two men.

Huxley was not always fortunate in the intellectual calibre of the men to whom he lectured in the Royal School of Mines. Many of the younger generation were studying in the universities, under Balfour at Cambridge, and under Rolleston, at Oxford. However, Saville Kent, C. Lloyd Morgan, George B. Howes, T. Jeffrey Parker and W. Newton Parker are representative biologists who were directly trained by Huxley. Many others, not his students, have expressed the deepest indebtedness to him. Among these especially are Prof. E. Ray Lankester, of Oxford, and Prof. Michael Foster, of Cambridge. Huxley once said that he had 'discovered Foster.' He not only singled men out, but knew how to direct and inspire them to investigate the most pressing problems of the day. As it was, his thirty-one years of lectures would have produced a far greater effect if they had been delivered from an Oxford, Cambridge or Edinburgh chair. In fact, Huxley's whole life would have been different, in some ways more effective, in others less so, if the universities had welcomed the young genius who was looking for a post and even cast his eyes toward America in 1850, but in those early days of classical prestige both seats of learning were dead to the science which it was Huxley's great service in support of Darwin to place beside physics, in the lead of all others in England. Moreover, Oxford, if not Cambridge, could not long have sheltered such a wolf in the fold.

What Haeckel did for evolution in Germany, Huxley did in England. As the earliest and most ardent supporter of Darwin and the theory of descent, it is remarkable that he never gave an unreserved support to the theory of natural selection as all-sufficient. Twenty-five years ago, with his usual penetration and prophetic insight, he showed that the problem of variation might, after all, be the greater problem; and only three years ago, in his 'Romanes Lecture,' he disappointed many of the disciples of Darwin by declaring that natural selection failed to explain the origin of our moral and ethical nature. Whether he was right or wrong, we will not stop to discuss, but consider the still more remarkable conditions of Huxley's relations to the theory of evolution. As expositor, teacher, defender, he was the high priest of evolution. From the first he saw the strong and weak points of the special Darwinian theory; he wrote upon the subject for thirty years, and yet he never contributed a single original or novel idea to it; in other words, Huxley added vastly to the demonstration, but never added to the sum of either theory or working hypothesis, and the contemporary history of the theory proper could be written without mentioning his name. This lack of speculation upon the factors of evolution was true throughout his whole life; in the voyage of the 'Rattlesnake' he says he did not even think of the species problem. His last utterance regarding the causes of evolution appeared in one of the Reviews as a passing criticism of Weismann's finished philosophy, in which he implies that his own philosophy of the causes of evolution was as far off as ever; in other words, Huxley never fully made up his mind or committed himself to any causal theory of development.

Taking the nineteenth century at large, outside of our own circles of biology, Huxley's greatest and most permanent achievement was his victory for free thought. Personally we may not be agnostic ; we may disagree with much that he has said and written, but we must admire Huxley's valiant services none the less. A reformer must be an extremist, and Huxley was often extreme, but he never said what he did not believe to be true. If it is easy for you and for me to say what we think, in print and out of print now, it is because of the battles fought by such men as Huxley and Haeckel. When Huxley began his great crusade the air was full of religious intolerants, and, what is quite as bad, scientific shams. If Huxley had entered the contest carefully and guardedly, he would have been lost in the enemies' ranks, but he struck right and left with sledge hammer blows, whether it was a high dignity of the Church or of the State. Just before the occasion of one of his greatest contests, that with Gladstone in the pages of the *Contemporary Review*, Huxley was in Switzerland, completely broken down in health and suffering from torpidity of the liver. Gladstone had written one of his characteristically brilliant articles upon the close correspondence between the Order of Creation as revealed in the first chapter of Genesis and the Order of Evolution as shown by modern biology. "When this article reached me," Huxley told me, "I read it through and it made me so angry that I believe it must have acted upon my liver. At all events, when I finished my reply to Gladstone I felt better than I had for months past."

Huxley's last public appearance was at the meeting of the British Association at Oxford. He had been very urgently invited to attend, for, exactly a quarter of a century before, the Association had met at Oxford and Huxley had had his famous encounter with Bishop Wilberforce. It was felt that the anniversary would be an historic one and incomplete without his presence, and so it proved to be. Huxley's especial duty was to second the vote of thanks for the Marquis of Salisbury's address—one of the invariable formalities of the opening meeting of the Association. The meeting proved to be the greatest one in the history of the Association. The Sheldonian theatre was packed with one of the most distinguished scientific audiences ever brought together, and the address of the Marquis was worthy of the occasion. The whole tenor of it was the unknown in Science. Passing from the unsolved problems of Astronomy, Chemistry and Physics, he came to Biology. With delicate irony he spoke of the '*comforting word, evolution*,' and passing to the Weismannian controversy implied that the diametrically opposed views so frequently expressed nowadays threw the whole process of evolution into doubt. It was only too evident that the Marquis himself found no comfort in Evolution, and even entertained a suspicion as to its probability. It was well worth the whole journey to Oxford to watch Huxley during this portion of the address. In his red doctor-of-laws gown, placed upon his shoulders by the very body of men who had once referred to him as 'a Mr. Huxley,' he sank deeper into his chair upon the very front of the platform and restlessly tapped his foot. His situation was an unenviable one. He had to thank an ex-Prime Minister of England and present Lord Chancellor of Oxford University for an address, the sentiments of which were directly against those he himself had been maintaining for twenty-five years. He said afterwards that when the proofs of the Marquis' address were put in his hands the day before, he realized that he had before him a most delicate and difficult task.

Lord Kelvin, one of the most distinguished living physicists, first moved the vote of thanks, but his reception was nothing to the tremendous applause which greeted Huxley in the heart of that University whose traditional principles he had so long been opposing. Considerable anxiety had been felt by his friends lest his voice would fail to fill the theatre, for it had signally failed during the Romanes Lecture delivered in Oxford the year before, but when Huxley arose he reminded you of a venerable gladiator returning to the arena after years of absence. He raised his figure and his voice to its full height, and, with one foot turned over the edge of the step, veiled an unmistakable and vigorous protest in the most gracious and dignified speech of thanks.

Throughout the subsequent special sessions of this meeting Huxley could not appear. He gave the impression of being aged, but not infirm, and no one realized that he had spoken his last word as champion of the law of Evolution. He soon returned to Eastbourne. Early in the winter he contracted the grippe, which passed into pneumonia. He rallied once or twice, and his last effort to complete a reply to Balfour's 'Foundations of Belief' hastened his death, which came upon June 29th, at the age of seventy.

I have endeavored to show in how many ways Huxley was a model for us of the younger generation. In the central hall of the British Museum of Natural History sits in marble the life-size figure of Charles Darwin; upon his right will soon be placed a beautiful statue of Richard Owen, and I know that there are many who will enjoy taking some share in the movement to complete this group with the noble figure of Thomas Henry Huxley.

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*ON THE CLASSIFICATION OF MUSEUMS.**

MUSEUMS may best be classified in two ways; by the character of their contents, and by the purposes for which they are founded.*

Under the first category they may be grouped as follows:

A. Museums of Art.
B. Historical Museums.
C. Anthropological Museums.
D. Natural History Museums.
E. Technological Museums.
F. Commercial Museums.

Under the second category they may be classed as

G. National Museums.
H. Local, Provincial or City Museums.
I. College and School Museums.
J. Professional or Class Museums.
K. Museums or Cabinets for special research owned by societies or individuals.

A. Art Museums.

1. The Museum of Art is a depository for the æsthetic products of man's creative genius, such as paintings, sculptures, architecture (so far as it can be shown by models, drawings and structural fragments) and specimens of the illustrative arts (such as engravings) and illustrations of the application of art to decorative uses.

2. The greater art collections illustrate, in a manner peculiarly their own, not only the successive phases in the intellectual progress of the civilized races of man, their sentiments, passions and morals, but also their habits and customs, their dress, implements and the minor accessories of their culture often not otherwise recorded.

3. Museums of art, wherever they may be situated, have a certain general similarity to each other in purpose, contents and method of management. Those which most fully represent the art of the communities

*From a paper on 'The Principles of Museum Administration,' read at the meeting of the Museums Association at Newcastle-on-Tyne, England, July 23, 1895. This portion of the paper, in modified form, was read before the Philosophical Society of Washington, January 18, 1896.

*In the references to special museums nothing has been further from my idea than to catalogue existing museums. Many of the most important are not even referred to by name. I have spoken only of those which are especially familiar to myself and which seem best to illustrate the idea in connection with which they are named.

to which they belong, other things being equal, are the most useful and are usually the most famous.

[Since the founding in Florence by Cosmo de'Medici, at the beginning of the sixteenth century, of the Museum of the Uffizi, perhaps the oldest museum of art now in existence, every great city in the civilized world has become the seat of a museum or gallery of art. Besides the great general collections of art, there are special museums devoted to the work of single masters, such as the Thorwaldsen Museum in Copenhagen, and the one at Brussels containing only the works of the eccentric painter, Wiertz; the Donatello Museum in the Bargello at Florence, and the Michael Angelo collections in the Florence Academy of Fine Arts and in the Casa Buonarrotti.]

B. Historical Museums.

1. The Museum of History preserves those material objects which are associated with events in the history of individuals, nations or races, or which illustrate their condition at different periods in their national life.

2. Every museum of art and every archæological museum is also a museum of history, since it contains portraits of historical personages, pictures of historical events, and delineations of customs, costumes, architecture and race characteristics.

[Historical museums are manifold in character, and of necessity local in interest. Some relate to the histories of provinces and cities. One of the oldest and best of these is the Provincial Museum of the Mark of Brandenburg in Berlin. Of the same class are the Museum of the City of Paris in the Hotel Canavelet, and the museums of the City of Brussels and the City of Antwerp.

Others illustrate the early history of a race or country, such as the Musée Gallo-Romain at St. Germain, the Romano-German Museum at Mainz, the Etruscan Museums at Florence and Cologna, the Ghizeh Museum near Cairo, the Acropolis Museum at Athens, and the Museums in Constantinople.

Such institutions as the Bavarian National Museum at Nuremberg and the German National Museum in Munich have to do with later periods of history, and there are throughout Europe numerous collections of armor, furniture, costumes and architectural and other objects, illustrating the life and arts of the middle ages and the later periods, which are even more significant from the standpoint of the historian than from that of the artist. Important among these are the Royal Irish Academy in Dublin, and the Musée des Thermes — the 'Cluny Museum'—in Paris.

Many of the cathedrals of Europe are essentially either civic or national museums, and such edifices as Saint Paul's and Westminster Abbey belong preëminently to the latter class.

There are biographical museums, either devoted to single men—like the Galileo, Dante, and Buonarrotti Museums in Florence, or the Goethe Museum in Weimar, and the Beethoven Museum in Bonn; to the great men of a nation, as the National Portrait Gallery of Great Britain, the German Valhalla at Ratisbon, etc.; or to great men of a special profession, such as the Gallery of Artists in the Pitti Museum of Florence.

In this connection would come also collections of autographs and manuscripts (like the Dyce-Forster Collection at South Kensington), and collections of personal relics.

Midway between the Museum of History and that of Biography stands the Dynastic or Family Museum, such as the Museum of the Hohenzollerns in Berlin, and that section of the Kunsthistorisches Museum in Vienna, which illustrates the history of the Hapsburgs. The Musée Historique de Versailles is similar in its aims.]

C. Anthropological Museums.

1. The Museum of Anthropology includes such objects as illustrate the natural history of Man, his classification in races and tribes, his geographical distribution, past and present, and the origin, history and methods of his arts, industries, customs and opinions, particularly among primitive and semi-civilized peoples.

2. Museums of Anthropology and History meet on common ground in the field of

Archæology. In practice, Historical Archæology is usually assigned to the latter, and Prehistoric Archæology to the former. This is partly because Historic Museums, which are usually national in scope and supported on documentary evidence, treat the prehistoric races as extralimital; partly because prehistoric material is studied to best advantage through the natural history methods in use among anthropologists but not among historical students.

[Ethnographic Museums were proposed more than half a century ago by the French geographer Jomard, and the idea was first carried into effect about 1840 in the establishment of the Danish Ethnographical Museum. In Germany there are Anthropological Museums, in Berlin, Dresden and Munich, and the Museum für Völkerkunde in Leipsic; in Austria, the Court and the Oriental Museums in Vienna; in Holland, the National Ethnographical Museum in Leyden, and smaller ones in Amsterdam, Rotterdam and at The Hague; in France, the Trocadero; in Italy, the important Prehistoric and Ethnographic Museums in Rome and Florence; in Spain, the Phillippine Collections in the Museo de Ultramar in Madrid; and in Hawaii, the Bernice Pauahi Bishop Museum, at Honolulu.

In England less attention has been given to the subject than elsewhere in Europe, the Christy Collection in the British Museum, the Pitt-Rivers Collection at Oxford and the Blackmore Museum at Salisbury being the most important ones specially devoted to ethnography. In the United States, the Peabody Museum of Archæology in Cambridge, the collections in the Peabody Academy of Sciences at Salem, and the American Museum of Natural History in New York are arranged ethnographically, while the ethnological collections in the National Museum in Washington are classified on a double system, one with regard to race, the other, like the Pitt-Rivers Collection, intended to show the evolution or development of culture and civilization without regard to race. This broader plan admits much material excluded by the advocates of ethnographic museums, who devote their attention almost exclusively to the primitive or non-European peoples.

Closely related to the ethnographic museum are others devoted to some special field, such as the Musée Guimet in Paris, which is intended to illustrate the history of religious ceremonials among all races of men, a field also occupied by one department of the National Museum in Washington. Other good examples of this class are some of those in Paris, such as the Musée de Marine, which shows not only the development of the merchant and naval marines of the country, but also, by trophies and other historical souvenirs, the history of the naval battles of the Nation; and the Musée d'Artillerie, which has a rival in Madrid.

Of musical Museums, perhaps the most important are Clepisson's Musée Instrumental in Paris; that in Brussels and that in the National Museum at Washington. The collection of musical instruments at South Kensington has had its contents selected chiefly with reference to their suggestiveness in decorative art.

The Theatrical Museum at the Academie Français in Paris, the Museum of Journalism at Antwerp, the Museums of Pedagogy in Paris and St. Petersburg, are professional rather than scientific or educational, as are also the Museum of Practical Fish Culture at South Kensington, the Monetary Museum at the Paris Mint, the Museums of Hygiene in London and Washington and the United States Army Medical Museum.

The value of archæological collections, both historic and prehistoric has long been understood. The Museums of London, Paris, Berlin, Copenhagen and Rome need no comment. In the Peabody Museum in Cambridge, the American Museum in New York, the Museum of the University of Pennsylvania and the National Museum in Washington are immense collections of the remains of prehistoric man in America.]

D. Natural History Museums.

1. The Museum of Natural History is the depository for objects which illustrate the forces and phenomena of nature—the named units included within the three kingdoms, animal, vegetable and mineral, —and whatever illustrates their origin in time (or phylogeny), their individual origin, development, growth, function, structure,

and geographical distribution, past and present; also their relation to each other, and their influence upon the structure of the earth and the phenomena observed upon it!

2. Museums of Natural History and Anthropology meet on common ground in Man. In practice the former usually treats of man in his relations to other animals, the latter of man in his relations to other men.

[In most national capitals, there are general museums of natural history, in which collections representing the three kingdoms of nature are included in one group. Among the oldest and most prominent types of this class are the British Museum of Natural History in South Kensington and the Musée d'Histoire Naturelle in Paris, and there are numerous others in the great cities of both hemispheres.

Among specialized natural history collections, a good type is the Museum of Comparative Zoölogy in Cambridge, Mass., founded by Agassiz to illustrate the history of Creation, as far as the present state of knowledge reveals the history, which was in 1887 pronounced by Alfred Russell Wallace to be far in advance of similar institutions in Europe, whether as regards the general public, the private student or the specialist.

Next in order after the Zoölogical Sections of the Museums in London and Paris, stand those of the Imperial Cabinet in Vienna; those in Berlin, Leyden, Copenhagen, Christiania, Brussels and Florence, and the La Plata Museum in Argentina, so rich in paleontological material.

The best type of the Botanical Museum is perhaps the Royal Garden at Kew, with its colossal herbarium and its special museum of economic botany, both standing in the midst of a great botanic garden. The Royal Botanical Museum in Berlin and the herbaria of the Imperial Botanical Garden in St. Petersburg are other examples.

Of specialized Geological Museums, the Imperial Cabinet in Vienna is a good type. The Museum of Practical Geology in London, founded to exhibit the collections of the Survey of the United Kingdom, and also in order to show the applications of geology to the useful processes of life, is another type of the same class. The Department of Economic Geology in the Field Columbian Museum of Chicago, an outgrowth of the Exposition of 1893, represents this idea in the new world.

Besides the great special museums, there are the museums of local natural history, intended to show the natural history of a special region, or, it may be, to illustrate its resources in some restricted branch.

The Royal Museum of Vertebrates in Florence, devoted to the vertebrate fauna of Italy, is a type of this class, and many local museums are so prominent in some special field (such as ornithology or entomology) that their other activities attract little attention.]

E. Technological or Industrial Museums.

1. The Museum of Technology or Industrial Museum is devoted to the industrial arts and manufactures, including:

1. Materials and their sources.
2. Tools and machinery.
3. Methods and processes.
4. Products and results.
5. Waste products and undeveloped resources.

The interests here treated are thus classified:

1. Primary or exploitative industries (as Agriculture, Mining or the Fisheries.)
2. Secondary or elaborative industries (as the Textile industries, the Ceramic Industries).
3. Auxiliary industries (as Transportation).
4. Technical professions (as Engineering, War, Medicine, Engraving).

The final product of one industry (primary or secondary) may become a material or tool in another art industry or handicraft.

2. Technological Museums come into contact with others, as follows:

With the natural history museum in respect to primary materials.

With the anthropological museum in the matter of tools and processes, especially if historical and retrospective collections are undertaken.

With the art museum in regard to certain products in which a high degree of æsthetic merit has been attained.

With the commercial museum in respect to all products and materials used in commerce and manufactures.

3. There is no such thing in existence today as a general Technological Museum, conducted upon a liberal plan and doing useful educational work. The possibility of establishing such a museum remains to be demonstrated. Attempts have been made at the close of various international expositions, but without success.

4. It is possible that experience may show that museum work in this field can best be done in connection with Museums of Natural History and Anthropology, organizing sections of economic zoölogy in connection with zoölogical museums, economic geology and botany, respectively, with the botanical and geological collections. In this way, at least, the natural products and the crude materials could be disposed of to advantage, and the manufactured products, tools and processes, on the other hand, could be shown by the Museums of Anthropology and Art, and in connection with the Mechanical or Patent Museums; though after all a factory in actual operation is the best place to study most modern industries.

[The constantly changing interests of commerce, dependent upon changing fashions and the caprice of markets, might safely be left to the Exposition and Fair, or, if need be, cared for by commercial organizations. In the City of Philadelphia, for instance, there is a most useful permanent exhibition of objects and materials used in the construction and ornamentation of houses, kept up by the 'Building Trades Association.']

F. Commercial Museums.

1. The Commercial Museum has to do with salable crude material and manufactured articles; with markets, means of commercial distribution, prices and the demand and supply of trade.

2. It may properly be connected with the Technological Museum, but for the fact that its purposes are likely to be more akin to those of the exposition or fair, involving a frequent renewal of exhibits in connection with commercial changes, and often certain features of competitive advertising or display on the part of private exhibitors.

3. The function of this class of museums is two-fold:

a. To exhibit to home producers the character and location of foreign markets.

b. To exhibit to foreign buyers the location and products of the home producer.

4. Although the usefulness of the commercial museum has not yet been fully demonstrated, it is conceivable that it might be of great service, could it be made the medium of wide international communication, and the means of a comprehensive system of exchange, through which the collections should be kept up to date and indicate the condition of the various markets of the world.

Essential to the success of such a museum would probably be a bureau of information, through which practical knowledge concerning prices, shipment and the quality of products might be obtained by manufacturers and other interested persons, and samples distributed for use in experiment and comparison.

[Examples of Commercial Museums may be found in the Musée de Melle at Ghent; that of the Chamber of Commerce at Liège, founded in 1888, and the Ottoman Commercial Museum, established in 1890 at Constantinople. These are too recent, however, to afford many lessons.]

G. National Museums.

1. National Museums contain the treasures belonging to national governments and are the legitimate successors of those treasure-houses of monarchs, princes, and ecclesiastical establishments which, until within the last two centuries, were the sole representatives of the museum idea. Every great nation now has a museum, or a group of museums more or less liberally supported,

and intimately connected with the educational undertakings of the government; often, when there are several great cities under one government, each has its own system of museums, and these together form the national system.

2. In most countries of Continental Europe the collections of the national universities form a part of the national museum system and are exceedingly efficient when thus administered.

3. National museums have opportunities which are not often shared by those under state control and their responsibilities are correspondingly great. They should occupy especially those fields which are not provided for in the other museums of the country in which they exist, and should not only refrain from competition with these museums, but afford to them unreserved coöperation.

[The principal purpose of a National Museum must be, as Prof. Jevons has well said, "the advancement of knowledge, and the preservation of specimens of works of art which hand down the history of the nation and the world." In other words, to serve as museums of record and research. It is by no means impossible, however, for them to render excellent service as educational museums, and quite independent of other considerations, they can rarely afford to sacrifice the material advantages gained from the display of popular exhibition series.

A serious obstacle to success in this direction is the vast amount of material which they all possess, and the lack of space in which to admit it. This difficulty may be partly overcome by a liberal assignment of objects to that portion of the study series which is not on exhibition.

A National Museum may not, it is true, advantageously attempt to install its separate departments in such manner as to produce the unity of effect possible in small specialized museums. This, however, is due to the fact that they are obliged to classify their material more strictly, for the attractiveness of a specialized museum grows largely from the fact that many illustrative objects are introduced into the exhibition series which are not strictly in place. The extreme attractivenes of fishery exhibitions, for instance, grows from the fact that so many interesting objects only incidentally connected with the fisheries may be introduced as a setting for the objects directly related to the fisheries.

A result of the same kind is obtained in the Museum of Practical Geology in London, where a selected series of products of all the arts deriving their material from the mineral kingdom —glass, pottery, gems, metal work and many similar groups—are brought in, legitimately increasing the attractiveness of the museum to the visitor and its instructiveness to the student.

Though the great general museum cannot vie in this respect with the local museum, it has a certain advantage of another kind in its very wealth of material, for the display of vast collections, assembled from all parts of the earth and covering, it may be, many acres of floor space, strictly classified and arranged so as to show mutual relationships, affords in itself the most impressive lesson. While in smaller museums the study of individual objects may be easier, in those of the other kind there is a better opportunity for the study of great general relationships.]

H. Local, Provincial or City Museums.

1. To museums of this class belongs the duty of preserving all that which is characteristic of the region or city in which they are located. Every State or Province should have an institution of this kind to care for material illustrating its own geology, zoölogy, botany and archæology. Every city should have a historical collection for memorials of events in its history and that of its representative men.

2. It is legitimate and desirable that Local and Municipal Museums should also enter upon general museum work of a scientific and educational character. They may form collections of a general character, in order that their visitors may see and study the unfamiliar products of foreign lands, as well as those of local interest. In museums of this class, models, casts, copies and pictures of objects not actually obtainable may properly be used.

3. It is often advantageous, in small communities, for the museum and public library to be combined under one roof and one management.

I. College and School Museums.

1. Museums of this class are intended for the use of teachers in connection with their class-room and laboratory instruction, and to reinforce the library in the no-less-important work which it performs for the student.

2. It need scarcely be said that it is impracticable for the smaller teaching museums connected with schools and colleges to carry out the thorough specialization which is attainable in large institutions. A small collection, however scanty and imperfect it may be, is of great value not only for study purposes in connection with some school or college and for exhibition to the local public of a small town, but also as a nucleus for future development.

3. The college or school museum often becomes the local or city museum for the locality in which it is situated, and what has been said about museums of the latter class then becomes applicable to the college museum.

J. Professional or Class Museums.

1. Professional museums are those formed specially for the use of groups of specialists and for the education of specialists. Here belong medical, surgical and pathological museums; military and naval museums; mechanical museums (such as those connected with patent offices and the Conservatory of Arts and Manufactures in Paris); museums for special arts (like the Textile Museum connected with the Gobelin establishment, the Museum of Porcelains, in Sèvres, the Museum of Mosaics in Florence), and certain scientific museums like that of the Geological Survey of Great Britain—the Museum of Practical Geology—the Museo Psicologico in Florence, founded by Mantegazza, and many others.

2. Such institutions, usually under the control of a society, school or specialized bureau, although they may allow inspection by the public, do not necessarily undertake general educational work, but may with propriety consult first, in all matters relating to administration and display, the interests of the class for which they are formed.

K. Private Museums or Cabinets.

1. Such collections undertake work in only one portion of the museum field, that of fostering scientific and historical studies, and so long as they are fruitful in this direction, the manner in which they are administered concerns only the persons by whom they are controlled. It is well that there should be many museums of this kind, and that those who work in them should not be encouraged to dissipate their energies in attempting to do too much of the work which belongs to institutions of other classes, and for which these should be held responsible. These are, to all intents and purposes, scientific laboratories.

2. The private collector is of the greatest service to the public museum. He can, by the use of private wealth or individual freedom, do many things which the officers of a public museum cannot.

3. Private collectors should be encouraged for educational reasons also, for it has been frequently remarked that the men who have had in youth the training afforded by forming a collection have derived therefrom great advantage over others, even though they subsequently pursued commerce or the learned professions.

4. The private cabinet is the school in which the museum administrator forms the tastes and receives the preliminary training which fits him for his profession. There is much truth in the remark of Jevons that the best museum is that which a person forms for himself. If everyone could do this there would be less need for public

museums, but since they cannot, the person who has formed a private collection can most successfully manage one for the use of the public, since he better than anyone else is able, in considering the needs of the museum visitor, to keep in mind that saying which is so useful a guide in museum practice—'Put yourself in his place.'

G. BROWN GOODE.

THE X-RAYS.

HELMHOLTZ, Hertz and Kundt, the three greatest physicists of modern Germany, have died within two years, and the friends of German science feared that this loss would be followed by a standstill in physics, or at least by a lack of really important discoveries. But now we have Professor W. Röntgen's investigations in the physical laboratory of the University in Würzburg, the importance of which does not stand behind the famous electrical discoveries of Hertz in Bonn. Röntgen has found a new kind of rays—he calls them the X-rays—which, though invisible to the eye, affect the photographic plate; which produce fluorescent phenomena; which pass through wood, metal and the human body; which are neither broken by prism and lenses nor reflected.

The chief facts about the X-rays are the following: It is well known that the discharges of a large Ruhmkorff induction coil produce in a vacuum tube, such as Crookes' or Hittorf's, colored rays which go in straight lines from the cathode to the glass of the tube. These cathode rays, which have been much studied, are visible to the eye and are well characterized by the fact that the magnet changes their direction; they do not pass thick cardboard, wood, etc. The place where these cathode rays reach the glass of the tube is the centre of Röntgen's X-rays. They are not visible and are not turned aside by a magnet; in short, they are not cathode rays, but are produced by them. If in a dark room we cover the tube by thin, black cardboard, nothing can be seen at all, even if we bring the eye in the direct neighborhood of the tube during the electric discharges. But if we now bring a card covered with barium platinocyanide near it the paper flashes up with every discharge, and this fluorescent effect is visible even if the paper is distant 2 meters from the tube, and it does not matter whether the varnished or the other side of the paper is directed towards the tube. The X-rays thus go through the black cardboard which is opaque to sunlight, and the same effect follows when a bound volume of a thousand printed pages is put between the tube and the fluorescent paper. We can measure the perviousness of the different substances to the new rays by the intensity of the light on the paper, comparing the effect with and without objects between the tube and the fluorescent surface. But there is also an objective way possible to study the perviousness, as the rays produce an effect upon photographic dry plates, which, of course, remains and allows us to control the subjective comparisons. Both methods show that wood is not much less pervious than paper; boards 3 cm. thick absorb very little. Hard rubber disks several centimeters thick do not stop the rays, and even aluminium plates 15 mm. thick do not make the fluorescence entirely disappear. Glass plates vary with the lead in them, those containing lead being less pervious. Platinum is slightly pervious, if the plate is not thicker than 0.2 mm., silver and copper can be a little thicker; lead plates 1.5 mm. thick are no longer pervious. All substances become less pervious with increasing thickness, a fact which is nicely demonstrated by photographs taken through tinfoils of gradually increasing number. The perviousness of substances of equal thickness seems chiefly dependent on the density, but special experiments showed that different metals are not equally pervious if the product of thickness and density is equal; the perviousness of platinum 0.018 mm. thick and a density of 2.15 equals that of lead 0.05 mm. thick, density 11.3 and that of tin 0.1 mm. thick, density 7.1, and that of aluminium 3.5 mm. thick and a density of 2.6. Aluminium may thus be 200 times thicker than platinum, while its density is one-tenth.

The fluorescent effect of the new rays is not confined to barium platinocyanide, but it occurs also on glass, calc-spar, rock-salt, etc. Prisms and lenses do not diffract the rays, nor do prisms of hard rubber or aluminium. With regard to reflection and diffraction the following experiment is interesting. It is well known that pulverized substances do not let pass much light owing to refraction and reflection. Röntgen found with pulverized salt, calc-spar, zinc and other substance that the ray pass through the powder with exactly the same intensity as through the solid substance. Objects with rough surface let it pass exactly like polished ones. The shadow of a round stick is in the middle darker than at the edges; the shadow of a metal tube is in the middle lighter than at the edges.

With regard to the effect on photographic plates, it must not be forgotten that lenses do not refract the rays and therefore ordinary photography is not possible; the pictures of the objects are only shadows. But these shadow-pictures can be taken in the closed wooden box of the camera in a light room, as the sunlight of course does not pass through the wood while the X-rays do. In this way Röntgen took photographs of a set of metal weights in a wooden box and of a thick wire wound as a spiral around a wooden stick; the wood was pervious, the metal of that thickness not, and so the shadows of the weights and of the wire are seen in the photograph, those of the wood scarcely at all. In the same manner he took the picture of a compass needle in the closed box. The door between two rooms did not hinder the chemical effect.

With regard to the nature of the X-rays it seems too early to say anything definite. Röntgen emphazises the fact that they show no refraction and probably therefore move in all substances with equal velocity and are transmitted by a medium which exists everywhere and in which are the molecules of the substances. That is they are ether rays, but not transverse ether waves like the visible or the ultra red or ultra violet invisible light; Röntgen supposes that they are longitudinal ether waves, the existence of which has for a long time been suspected by physicists. Researches regarding many other qualities of the new rays are in progress, and their results may clear up the theoretical interpretation.

It may be that the practical importance of the discovery is equal to the theoretical. It is well known throughout the world that the physical laboratories of Germany have no windows looking towards the patent office. The hunting for practical inventions is not usually important for theoretical science, but the progress of theory usually has practical applications. One practical result in this case is already clear, as the new rays pass boards but not thick metal plates, so they pass the organic substances of the human body, such as skin, muscles, etc., but not the bones. As the metal weights in the wooden box can be photographed, so can photographs of the human bones be taken. Röntgen has put his hand between the tube and the dry plate in the closed camera; the photograph shows clearly all the bones of the hand without the flesh and skin, and the gold rings seem to hang in the air. The value of such a method for medical diagnosis is clear. Fractures and diseases of bones can be examined by photographic plates and metal pieces in the body, for example, needles, bullets, etc., can be found by this method. It will be a matter of the future to learn whether the rays have psycho-physiological effects.

The newspapers report that the whole thing was discovered by mere chance. Röntgen saw the effects on photographic papers which by chance were near to a covered tube during the discharge. This chance origin is not probable, as Lenard, the assistant of Hertz, has been working in the same direction for a long time, and many preparatory experiments by Röntgen himself cleared slowly the way. But suppose chance helped. There were many galvanic effects in the world before Galvani saw by chance the contraction of a frog's leg on an iron gate. The world is always full of such chances, and only the Galvanis and Röntgens are few.

HUGO MÜNSTERBERG,
Harvard University.

FREIBURG, BADEN, January 15, 1896.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR RÖNTGEN'S DISCOVERY.

THE transmission through wood and other substances of the rays from a Crookes' vacuum tube, discovered by Prof. Röntgen, is reported to have been confirmed by Prof. Klupathy of Pesth, Prof. Domalip of Prague, Prof. Czermak of Gratz, and Mr. A. A. C. Swinton of London. The photographs have been exhibited before several scientific societies and by Prof. Röntgen to the Emperor of Germany, from whom he has received a decoration.

Mr. Swinton writes to the *Standard* that with Mr. J. C. M. Stanton he has obtained distinct proof that the radiations in question do pass easily through various substances that are quite opaque to ordinary light, and do produce strong impressions upon ordinary photographic plates entirely incased in light-proof material. Indeed, all substances that he has so far experimented on in his laboratory appear to be transparent to these radiations, even sheets of ebonite, carbon, vulcanized fibre, copper, aluminium and iron, though there is considerable variation in degree. It is thought that the new method of photography may have important applications, not only in surgery, but also in metallurgy, by revealing flaws, inequalities and fractures in metals.

Hertz discovered that cathode rays pass through metal films not translucent to ordinary light, and that Dr. Lenard and others have published careful experiments on the subject. Attention has been called to Prof. Zeugen's having photographed Mt. Blanc, in 1885, by the cathode rays. Prof. Röntgen, however, states that the rays discovered by him, which he calls X-rays, are not cathode rays, as they are not refrangible nor affected by magnetic influences, but that they are more probably longitudinal waves in the ether.

While Hertz and Lenard hold that the cathode rays are vibrations in the ether or even light of short wave-length, Crookes and J. J. Thomson have urged that the rays are negatively charged matter traveling with great velocity. M. Perrin reported to the Paris Academy, on December 30th, experiments which tend to show that the latter view is correct, and some relation will probably be found between cathode rays and the X-rays.

PHYSICS.

BY constructing what might be termed a reversed level, A. Toepler obtains an instrument which he calls a 'pressure level.' It consists of a tube bent to a slight angle at its middle point; the two ends are equally inclined to the horizontal. A short column of a light liquid fills the central portion of the tube. It will be readily seen that if the two open ends are connected with two receivers of any sort, the liquid will, by its position, give the difference of pressure in them. This method of differentially measuring pressures, Mr. Toepler applies (*Wied. Ann.*, Vol. 56, 1895) to measure the difference in weight of two columns of air at different temperatures but both under the same pressure. A long series of determinations of absolute temperatures bears witness to the efficacy of this method, and theoretical considerations remove some apparent objections and give to it certain advantages over the ordinary form of air thermometer.

THE old question as to the existence of Volta's 'contact electricity' is again taken up by C. Christiansen (*Wied. Ann.*, 56, 1895.) who, with an apparatus employing the drop electrode, has investigated the behavior of magnesium, aluminum, cadmium, zinc, tin, lead, iron, platinum, nickel, copper, mercury and carbon in atmospheric air, hydrogen, carbonic acid gas and oxygen, and arrives at the conclusion that oxygen may be, if it is not always, the cause of potential differences between metals in contact, and he is of the opinion that it is a polarization by the gas, just as oxygen or hydrogen polarizes platinum.

G. Meyer investigated an allied subject with the Lipmann capillary electrometer testing the combinations of mercury, and lead, copper, tin and zinc amalgams in sulphuric and hydrochloric acids, potassium chloride, iodide and sulphocyanide, and sodium sulphide. A further contribution to our knowledge of the dielectric constant is made by S. Silberstein, who has determined this constant for various mixtures of benzol and phenylethylacetate, and finds that the results agree well with the conclusions derived from theoretical considerations. (*Wied. Ann.* Vol. 56, 1895.)

W. H.

ASTRONOMY.

THE Astronomical Society of the Pacific has just published an account by Prof. Tucker, of the methods he is using for the investigation of the division errors of the Repsold circle of the Lick Observatory. We are glad to see the principle of using the auxiliary circle for the purpose of investigating the principal circle. This plan has many advantages, but its weak point of course is that the two circles are at some distance from each other and are read by different microscopes. It may not be generally known that a transit circle was constructed by Messrs. Cooke & Sons for Mr. Newall, under the superintendence of Mr. Marth, in which the divisions of the two circles could be brought into the field of view of one microscope simultaneously. The errors of that circle, however, were never investigated.

But it may be questioned whether the results ever justify the expenditure of the great amount of time and labor involved in such investigations as that of Prof. Tucker. Probably the same amount of energy given to observation of the stars, taking care of course to shift the circle from time to time, would be of greater benefit to astronomical science. Even if the division error of any given line could be determined with complete precision with the telescope pointed at the zenith, this division error would not hold true when the telescope is directed elsewhere. Nor is this brought about by flexure alone. It is found that if we determine the division errors of a straight scale, these errors are completely changed when the scale is reversed end for end. No doubt unavoidable differences in the illumination and the eye of the observer are responsible for these unfortunate facts. But facts they are, and the cause of much wasted labor.

THE 1890 volume of the *Annuaire* published by the Bureau des Longitudes has been issued. It contains the usual mass of material devoted to astronomical and other science. Among the appendices are articles by MM. Cornu and Janssen, which are of general interest. The list of members of the Bureau contains the names of two Americans: Dr. B. A. Gould and Mr. G. Davidson. The latter gentleman is described as 'directeur de l'observatoire de Californie et du Service geodesique.'

H. J.

GENERAL.

THE herbarium of the late Prof. Daniel Cady Eaton has been presented by his family to Yale University. The herbarium contains over 65,000 sheets, and is especially rich in North American ferns and mosses.

THE library of the University of Pennsylvania has acquired the scientific library of the late Prof. John A. Ryder. It has also secured the Bechstein Library of German Philology and Literature, containing about 20,000 bound volumes and pamphlets.

Nature states that Prof. Sollas, F. R. S., will leave in March for Sydney, to take charge of an expedition that is being dispatched to make deep borings in a coral atoll. The scheme, which is supported by a strong scientific committee, has been financed by the Royal Society to the extent of £800; and the government are placing a gunboat at the disposal of the party, to convey them from Sydney to Funifuti, in the Central Pacific, which has been selected as the scene of operations. Mr. W. W. Watts writes to the same journal that it would have been impossible to undertake the work without the assistance of the Departments of Mines of the New South Wales government, which has granted to the committee a complete set of boring tubes and appliances.

THE Field Columbian Museum, of Chicago, will send a commission, including Professor D. G. Elliot, one of the curators, and Mr. C. A. Aikley, the taxidermist of the Museum, to Central Africa to collect zoölogical specimens. It is proposed to leave Chicago about March 1st, and to spend six months in Africa.

THE New York section of the American branch of the Society for Psychical Research will have its next meeting at Columbia College, on February 1st, at eight P. M. Prof. William James will preside and will make an address. Papers will be read by Prof. J. H. Hyslop on 'Experiments in Crystal Vision,' and by Prof. W. R. Newbold on 'Three Cases of Subconscious Reasoning.' A meeting will be held in Boston, at Allston Hall, on the preceding evening.

AT the annual meeting of the Anthropological Society of Washington, held January 21st, Prof. Lester F. Ward was elected President for the ensuing year; Surgeon General George M. Sternberg, Dr. Frank Baker, Mr. W J McGee, and Mr. George R. Stetson, Vice-Presidents; Dr. J. H. McCormick, General Secretary; Mr. Weston Flint, Secretary to the Board of Managers; Mr. Perry B. Pierce, Treasurer; and Mr. F. W. Hodge, Curator. Dr. Cyrus Adler, Mr. Joseph D. McGuire, Mr. James A. Blodgett, Dr. Washington Matthews, Dr. Thomas Wilson, and Prof. J. Ormond Wilson were elected Councilors. Dr. Robert Fletcher, Prof. Otis T. Mason, and Major J. W. Powell, former presidents of the Society, are *ex-officio* members of the Council.

AT the annual meeting of the Royal Meteorological Society, on January 15th, Mr. E. Mawley was elected President, and the retiring President, M. R. Inwards, delivered an address on Meteorological Observatories.

THE third course of annual lectures of the Linnæan Society, in connection with the American Museum of Natural History, is as follows:

January 14, 1896. *The Indians of Vancouver Island.* By Dr. Franz Boas, American Museum of Natural History.

January 18th. *The Origin and Distribution of North American Mammals.* By Prof. W. B. Scott, Princeton College.

March 3d. *Two Months in Greenland.* By Prof. William Libbey, Princeton College.

MR. C. E. BORCHGREVINK has sent his mineralogical collection from South Victoria Continent to Dr. John Murray, F. R. S. Mr. Borchgrevink holds that his specimens are especially valuable as proving the existence of an Antarctic continent.

THE cost of sending an expedition from the Lick Observatory to Japan to observe the approaching eclipse of the sun will be defrayed by Mr. C. F. Crocker, of San Francisco.

A CABLEGRAM to the daily papers states that Dr. Behring has discovered an anti-cholera serum, and announces that a public demonstration of its properties will be made at an early date.

WE learn from *La Nature* that the Venetian Society for the encouragement of pisiculture has secured, from the Aquarium of the Trocadero at Paris, spawn of the California salmon, to be placed in the streams of the province.

Nature states that Mr. John Donnell Smith is still in Nicaragua, in pursuance of his botanical explorations, which have already been so fertile in additions to the Central American flora, and that M. R. Schlecter is intending shortly to start on a two years' botanical exploration of the south and east of Africa. His program includes a prolonged stay in Namaland, the Transvaal, Coud-Bockeveld, Limpopo and Matabeleland as far as the Zambesi. Subscriptions for his collection will be received by Prof. Schumann, Botanical Museum, Grünewald str., Berlin. They will be at the rate of 35 marks the hundred.

LIEUT. E. ASTRUP, the Arctic explorer who was with Lieut. Peary on his first expedition to Greenland, was found dead on Jan. 19th in a valley in the Dovrefjeld Mountains, near Jerkin, Norway. He started from Christiania before Christmas to make an exploring trip on skis in the mountains. He had apparently been overcome by fatigue and cold. Lieut. Astrup was only 31 years of age.

At a general meeting of the London Institution of Electrical Engineers, on January 16th, Mr. Crompton, the retiring President, gave up the chair to Dr. John Hopkinson, who delivered his inaugural address, reviewing at length the progress which had been made in the direction of practical applications of electrical knowledge during the past sixty years.

We have received the first bulletin of the *Institut International de Bibliographie*, which will hereafter be published from the office of the Institute, 11 Rue Ravenstein, Brussels. It contains the address of Chev. Descamps given at the close of the recent International Congress of Bibliography, the rules of the Institute, the plans proposed for a general bibliography by MM. H. La Fontaine and P. Otlet, and notes on the decimal system of classification.

The *Engineer* has offered a prize of a thousand guineas for a contest of horseless carriages to take place in England in October, and arrangements are being made by American manufacturers for a similar contest between Jersey City and Philadelphia with a prize of $5,000, to take place as soon as the roads are in good condition in the spring.

Arrangements have been made for the following lectures to be given before the Royal Institution before Easter: Dr. J. G. McKendrick, professor of physiology in the University of Glasgow, six lectures on 'Sound, Hearing and Speech;' Prof. Charles Stewart, Fullerain professor of physiology, R.I., eleven lectures on the 'External Covering of Plants and Animals: its Structure and Functions'; Mr. H. Marshall Ward, Professor of Botany in the University of Cambridge, three lectures on 'Some Aspects of Modern Botany'; Lord Rayleigh, professor of natural philosophy in the Royal Institution, six lectures on 'Light.' The Friday evening meetings will begin on January 17th, when a discourse will be given by Lord Rayleigh on 'More about Argon.' Succeeding discourses will probably be given by Prof. Burdon Sanderson, Dr. John Murray, Dr. Edward Frankland, Prof. T. R. Fraser, Prof. Dewar and other gentlemen.

According to the *Lancet* the trustees of the Bellahouston fund have made the following additional bequests to Glasgow Infirmaries: 1. To the Royal Infirmary (1) a grant of £2,500 in supplement of an equal sum already paid by the trustees for the better equipment of the medical school; and (2) a grant of £7,500 towards the erection of a pathological museum and laboratory and another operating theatre, to be called the 'Bellahouston theatre.' 2. To the Western Infirmary (1) a grant of £3,500 for the erection of another operating theatre, to be called the 'Bellahouston theatre'; and (2) a grant of £5,000 towards the erection of pathological buildings. 3. To the Victoria Infirmary a grant of £6,000 for the erection and equipment of a dispensary for out-patients, to be called the 'Bellahouston dispensary.'

The annual loss to Pennsylvania by forest fires is estimated by the State Forestry Commissioner to be at least $1,000,000. He holds that the fires are always due to ignorance, carelessness or crime, and that these may be controlled.

The multiplication of laboratories for the study of experimental psychology has nearly ceased, only because almost every school of any importance now possesses such a laboratory. It is already evident that a second era in this movement is beginning. A few weeks ago it was announced that the department of psychology at Cornell University had just taken possession of splendid new quarters on the fourth floor of Morrill Hall, comprising a series of nine rooms and some 4000 feet of floor space. Word now comes from Nebraska that psychology has just moved into the first floor of the new library building and occupies a series of five rooms with a floor space of about 3000 square feet. The rooms comprise a lecture room that will accommodate one hundred students; a study that may be used also as a private laboratory; a shop equipped with lathe and tools, to the value of about $300 (this room is also used as laboratory at certain hours); and two large rooms for general laboratory practice, one of which has a small dark room cut off.

The building is by far the best constructed, not only of the University buildings, but of all the State buildings. The first floor is finished in hard pine, with two-inch hard maple floor laid in cement. One of the laboratory rooms is provided with three stone piers, extending directly into the ground with tops 20x24 inches. This same room has six windows, each $7\frac{1}{2}$x$4\frac{1}{2}$ feet. Double shades, white and black, regulate the light. One hundred and fifteen students are now taking work in psychology in the University of Nebraska.

UNIVERSITY AND EDUCATIONAL NEWS.

GROUND has been broken for the first of the four buildings of the new biological school of the University of Chicago, which is to be erected with part of the $1,000,000 recently given by Miss Culver. It is proposed to erect special buildings for zoölogy, botany, anatomy and physiology, instead of one biological building, as planned before the receipt of Miss Culver's gift.

THE College of New Jersey, Princeton, will celebrate the 150th anniversary of its foundation in October next. It is proposed to hold an academic festival on October 20, 21 and 22, at which time it is said the name of the institution will be altered to Princeton University. An effort will be made to largely increase the endowment of the College, the money to be used chiefly in developing the University work.

ELIZA M. MOSHER, M. D., of Brookly, N. Y., has been appointed a professor of hygiene in the University of Michigan.

THE Fellows of the Royal College of Surgeons, London, on January 2, declared themselves, by a vote of 72 to 10, in favor of admitting women to the examinations and diplomas of the College.

VASSAR College has received $8,000 from Miss Helen Gould for the foundation of a scholarship.

THE Senate of Toronto University has made a claim against the Province of Ontario, or the Dominion of Canada, for more than $100,000.

THE University of Pennsylvania has received a gift of $5,000 from Mr. Charles M. Swain and $5,000 anonymously, the money to be used without restrictions.

THE will of the late Martin Brimmer, of Boston, to take effect on the death of his wife, bequeaths $50,000 to Harvard University.

DISCUSSION AND CORRESPONDENCE.

THE METRIC SYSTEM.

EDITOR OF SCIENCE: I enclose a copy of House Bill No. 2758 in regard to the Metric System. This bill has been introduced by Hon. D. Harley, of Brooklyn, N. Y., after consultation with the Secretary of the American Metrological Society and officers of the U. S. Government (Gen. Duffield, Superintendent of U. S. Coast and Geodetic Survey; Professor Newcomb, of the Nautical Almanac Office, and Mr. Tittmann, of the Coast and Geodetic Survey), and others. The Committee on Coinage, Weights and Measures, of the House of Representatives, has the bill in charge. Hon. C. W. Stone is Chairman of the Committee.

It is hoped that those interested in the matter will urge on the Committee the great desirableness of a favorable report to the House.

J. K. REES.

AMERICAN METROLOGICAL SOCIETY,
OFFICE OF SECRETARY,
NEW YORK, January 24, 1896.

The bill to fix the standard of weights and measures by the adoption of the metric system of weights and measures is as follows:

"*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That from and after the first day of July, eighteen hundred and ninety-seven, all the Departments of the Government of the United States, in transaction of all business requiring the use of weight and measurement, shall employ and use only the weights and measures of the metric system, as legalized by Act of Congress approved July twenty-eighth, eighteen hundred and sixty-six.

"SEC. 2. That from and after the first day of July, eighteen hundred and ninety-nine, the metric system of weights and measures shall be the only legal system of weights and measures recognized in the United States.

"SEC. 3. That the tables in the schedules annexed to the bill authorizing the use of the metric system of weights and measures, passed

July twenty-eighth, eighteen hundred and sixty-six, shall be the tables of equivalents which may be lawfully used for computing, determining, and expressing in customary weights and measures the weights and measures of the metric system."

IMPROVED BLACKBOARD.

Editor of Science: Several persons have enquired about the blackboard mentioned in your columns recently. May I describe it briefly: A sheet of ground glass a meter square is framed and the frame is hinged into a very shallow cupboard fastened to the wall. A false bottom covered with padded serge fits this cupboard loosely, and when the door is closed and fastened presses firmly against the glass on the inside. It then forms a fine blackboard as the ground glass surface is perfect for use with crayons.

If the door be opened and a sheet of white paper fastened to the false bottom by thumb tacks, it becomes an equally useful drawing slate for colored crayons. If in the place of the white paper a sheet of drawings as of crystal forms or geometrical figures, or outline maps be put behind the glass they show through so that all modifications of the primary form beneath can be drawn on the glass and in proper relation to this primary. It is only needful that the false bottom shall press firmly against the glass, and this is easily effected by having it held in place by four screws placed near the corners whose heads are countersunk in the false bottom. The latter moves freely on these screws and four spiral springs which are slid on the screws behind it press the serge firmly against the glass. Ben. K. Emerson.

Amherst, Mass., January 14, 1896.

SCIENTIFIC LITERATURE.

Elementary Physical Geography. By Ralph S. Tarr. 12 mo., pp. l–xxxl., 1–488, 29 plates and charts, 267 diagrams and photographs. Macmillan & Co. 1895. Price $1.40.

Physical geography is no longer a mere description of the earth's surface, but includes also an enquiry as to how its features came to be what they are. The recent ideas that have vivified this study and placed it on a scientific basis may be seen by contrasting the writings of Ritter, Humboldt, Guyot and others of what may in all courtesy be termed the old school, with the book before us. In the older books, which are by many persons still considered fountains of geographical knowledge, the leading theme is the description of the earth; in Tarr's physical geography the dominant idea is how the features of the earth came to have their present characteristics.

In descriptive physical geography the continents are sometimes treated as fragments of broken china, which, by the exercise of much ingenuity and an active imagination, are made to fit together with more or less accuracy, thus leading the student to fancy that at one time they were united. In rational physical geography each continent is shown to have a life history, and to have been modified by elevation and subsidence, and varied in relief by erosion and sedimentation. In the modern view of nature even the largest of land masses are found to be unstable forms; the processes to which they owe their elevation above the sea, as well as their outlines and relief, are still active, and additional changes are to come. Mountains are no longer to be studied as finished forms, but as representing all stages of growth, adolescence, maturity and old age. River valleys are not merely drainage canals, the lengths and breadths of which are to be memorized, but each one has a history written in its terraces and flood plains, in which evidences of elevation and depression of the land, climatic changes, the influence of rock structure, etc., can be read.

The modern ideas referred to, which, so to speak, have blown away the mist from the landscape and revealed its varied beauties, are truthfully reflected in the book before us. One who is familiar with the progress of geological study in America sees, as he turns its pages, an epitome of the results brought by many conscientious workers from the mountains and valleys, with much labor and thought. Most of all, it is flavored with the studies of Prof. Davis, of Harvard, in whose class room and from whose writings Prof. Tarr has gained much of his inspiration. The great sources both of facts and ideas, as must of necessity be the case in all attempts to write the physical history of North America, with which the book is mainly concerned, are the reports of the geological surveys of Canada, the United States, and of many individual States. The results of these great surveys reach the people and the schoolroom directly, to only a comparatively limited extent; probably their greatest popular usefulness lies in the fact that they are mines of wealth to those who attempt to popularize and disseminate scientific knowledge.

Physical geography is treated by Prof. Tarr under three leading topics: *The Air*, *The Ocean*, *The Land*.

The Air: The part treating of the air begins with an account of the relations of the earth to other members of the solar system and is in fact an introduction to the entire subject of physical geography. This chapter probably differs less than any other portion of the book from older treatises on the same subject. Necessarily the subject-matter to a great extent is borrowed from astronomy.

The discussion of atmospheric temperatures, moisture, condensation, clouds, etc., the nature and origin of storms, distribution and characteristics of climate and other similar phenomena, brings out the results of the most recent studies in this important branch of the subject. To a great extent these chapters are a compend of Davis' Meteorology, a book that should be at hand when instruction in this portion of the subject is given.

The Ocean: In dealing with the geography of the sea, the rich store of knowledge resulting from the Challenger, and other similar expeditions, furnishes the data for presenting a comprehensive outline of the results of recent surveys. Some of the subdivisions of the subject as treated are: methods of deep-sea explorations; topography of the sea bottom and of coast lines; deposits now forming on the sea floor; temperatures; chemical composition, circulation, etc., of sea waters; general distribution of life in the sea; the causes of currents and tides; and the effect of the movements of sea water are discussed and illustrated by diagrams, maps and photographs.

The Land: It is in this portion of the book that the greatest advances, both in geography as a science and in methods of study, are shown. The processes by which the rocks forming the land are disintegrated and carried away are discussed and the resulting changes in topography clearly described. The fact that all rocks which rise above sea level are constantly yielding to chemical and mechanical agencies and being removed by streams in solution and suspension leads to the recognition of a fundamental principle, first definitely stated by Major Powell, which is of wide application in both geography and geology. This tendency to reduce all land areas to the level of the sea, or to *baselevel*, as it is termed, if not counteracted by movements of elevation, will result in the production of plains. Such plains of subærial denudation, or *peneplains*, are a characteristic feature of many regions.

A knowledge of the way in which streams deepen and broaden their valleys, and slowly adjust themselves to rock structure, gives meaning to a multitude of geographic forms, that would otherwise appeal to the eye alone without awakening a mental picture of the long series of changes of which they are the result.

The deposition of the waste of the land in flood plains and deltas, and its distribution over the bottoms of lakes and on the ocean's floor, illustrates other phases of the never-ending changes that attract the eye of the geographer. These wide reaching processes and the character of the results they produce are tersely outlined.

The characteristics of glaciers and the changes they bring about in the topography of the land, both by erosion and deposition, form a chapter that cannot fail to awaken interest especially in the minds of students whose homes are in the northeastern States or Canada, since not only the general expression but almost every detail in the landscape with which they are familiar is an inheritance from an ice invasion.

The study of coast lines shows that the agencies by which the relief of the surface of the land is modified are supplemented by analogous agencies which are constantly altering the direction and varying the details of the margins of continents and islands.

Many of the results of erosion and deposition are illustrated by home example and supplemented by photographs of American scenery.

The book is emphatically an American book, and especially well adapted for American students.

A chapter is devoted to volcanoes, earthquakes, geysers; another to the general topography of the land. The relations of man to his environment, and the products of the rocks that are of leading economic importance, are also considered as fully as the space available will allow.

An important feature of the book, and one that places it in advance of all other similar treatises, is the free and one might say almost lavish use of photographs. While some of them are so much reduced and so poorly printed that they have lost their beauty, and are even obscure and of little value, yet the preference, in many instances, of photographs over sketches and wood engravings for text-book use is thoroughly demonstrated.

At the close of each chapter there is a short list of books which will aid the teacher in extending the subjects outlined in the text, and enable him to add fresh description and discussions from authoritative sources.

Now that a text-book of rational physical geography, designed for school-room use, is available, which presents the modern aspects of the subject as well, perhaps, as could be done in an elementary treatise, there is no longer an excuse for practically excluding this attractive and stimulating branch of nature study from our schools. It has frequently been stated that it is useless to attempt to teach physical geography in its modern dress, for the reason that properly trained teachers were not available. With Tarr's book in hand and works of reference available, there is no reason why many graduates of normal schools and colleges should not prepare themselves for this work. Without, however, a certain indescribable sympathy with nature, a deep appreciation of the beauties of form and color in a landscape, and a quenchless thirst to know how the numberless features of the land, sea and sky came to be what we find them, one need not expect great success as a teacher of physical geography. Given a love of nature and such a guide-book as Prof. Tarr has compiled, and the path leading to the commanding height from which the history of the earth's surface can be read as from a printed page may be readily reached.

Necessary adjuncts to a text-book of physical geography, are maps, especially of the region where the teacher is located, large-sized photographs or lantern views, globes, models, etc. These appliances, however, are of comparatively little use, unless, as expressed by Davis, 'the outsight is aided by the insight.'

In closing I wish to say, as has been stated in the report on a recent conference in geography, that the study of physical geography demands an advanced position in both school and college training, for the reason that it develops the power of observation, the powers of scientific imagination, and the power of reasoning.

ISRAEL C. RUSSELL.

The Great Frozen Land: Narrative of a winter journey across the Tundras and a sojourn among the Samoyads. By FREDERICK GEORGE JACKSON. Macmillan & Co., New York. 1895.

In this pleasantly written and by no means over-scientific volume, the leader of the Jackson-Harmsworth Polar Expedition (now passing its second winter in the region of Franz Josef Land) gives the narrative of a long sledge-journey across the frozen lands of northern Russia, from the Yugor Strait to the Varanger Fjord—a journey undertaken primarily with a view of testing certain requirements of travel which might be found necessary in the more arduous Polarctic work for which the author had been preparing. The land-traverse compassed some twenty-five hundred miles across the Great and Little Tundras, and over a solitude, as stated in the prefatory remarks of Mr. Montefiore, 'through which no Englishman had ever passed; of which no sufficient map existed; whose table of river-labyrinths, ancient beaches and lost bays had never been told; of whose winter climate no account was to be discovered in the English tongue.' Just why these deficiencies in English knowledge and energy are so strongly emphasized does not appear clear, and it can, perhaps, hardly be said that Mr. Jackson's travels acquire importance through them alone.

There is much in this book to interest the general reader, and particularly acceptable are the glimpses of cold nature which we obtain here and there scattered through the pages, and the inner vista into the natural life of those peculiar children of the north, the Samoyads. Mr. Jackson lived with them in cleanliness and dirt, in health and distemper, and behind pony and reindeer, and is, therefore, in a position to give a picture that is neither under-colored nor over-colored. Apart, however, from a general broad discription of both people and country there is little in the book to tax the mind of the inquiring scholar, and least that of the scientist. Zoölogical, botanical and geological data are exceedingly meagre, and, owing largely to the loss of the thermometer record-book for the months of December and January, there is little to add to meteorology. The lowest reading of the thermometer was found on December 5th,—36.°5 F. Mr. Arthur Montefiore, the editor of Mr. Jackson's journals, contributes a chapter on the Samoyad language, a series of translations on Samoyad folk-tales from Castrén's *Ethnologische Vorlesungen*, and an appendix on the 'object, method and equipments' of the Jackson-Harmsworth Polar Expedition.

The tone of the book, both as it is found in the main text and in the contributions of the editor, leads to a lingering suspicion that it is conceived too much in a spirit of enthusiasm to permit it everywhere to be followed as a safe guide. Thus, in the prefatory remarks the reader is led to believe that the journey was undertaken in the region of 'the Pole of Extreme Cold,' but between the minimum thermometric registry that has been above noted (–36°.5 F.) and the cold of Yakutsk and Verkshojansk, minus 75°–82° F. (or, according to report two years ago, –92°), there is a vast difference—the difference, in fact, between Minnesota and what is experienced by almost every Arctic expedition wintering in the far north. We are informed on page 160 that a journey of 700 versts (about 470 miles) was accomplished in seven and a-half days, on two sledges, 'one horse to each sledge,' and that at the end of the journey the horses 'trotted into Pinega apparently as fresh as paint.' To travel sixty miles a day for seven days in succession is certainly no ordinary feat for horses even of the Russian type, and many a carrier would be welcomed for this undertaking into the camps of the Russian or German military posts; but what dignity or honor would be conferred upon a Zirian who drove three reindeer, within a period of twenty-four hours, over a distance of 1200 versts (800 miles)! It is hardly to be wondered at that the team died on the following day (p. 74).

Almost the only fact of physiographic importance which is noted is the occurrence of raised beaches near the mouth of the Piatsoworyaha River, where the amphitheatre of an old bay extends backward a distance of some nine miles from the present seashore. "Step above step there ranged the old seabeaches, following the lines of the higher land immediately behind them, and girding with a terraced rampart the level basin of salt marsh into which the waves once rolled. * * * * * These old seabeaches, I may add, continued for many miles westward—notably that which is now six miles from the sea, and lies just to the east of the Pechora River—and most certainly would repay the attention of a geologist if he could visit them in summer" (p. 129).

Mr. Jackson is now working in an important field of exploration, and scientists, no less than geographers, cannot but wish him success in an undertaking which requires for its accomplishment a more than ordinary amount of courage and determination, and a knowledge of the kind which must be forced upon every traveler who attempts the long passage of the Great Frozen Land.

ANGELO HEILPRIN.

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA, January 11, 1896.

A Complete Geography. By ALEX. E. FRYE. Ginn & Co., Boston, Mass. 1895.

Since the publication, last year, of Frye's Primary Geography, the appearance of a larger book for grammar school use, promised by the same author, has been awaited with much interest. This book is now at hand. Its plan, like that of the Primary Geography, departs widely from the beaten track followed by most writers of school geographies. This has generally consisted of an introductory chapter on the earth's mathematical features, followed by a condensed review of physical geography, after which the several continents are successively described in their various aspects, the United States naturally receiving the chief attention, and the physical features of each region being considered in close connection with its political and industrial features. But in the new book the most striking feature is the division of the entire subject into two well-marked fields: the first, which occupies some two-thirds of the book, being devoted to the physical features of the earth, and the rest dealing with political geography.

This plan will commend itself to many. The physical features of the earth are the foundation upon which the history of the nations has been wrought out to its consummation in the political geography of our own day; are, in fact, the mould which has determined the present aspect of political geography. It seems appropriate, therefore, that these relatively permanent physical features should receive primary, and the relatively transient political facts secondary attention, and that a full and clear understanding of these fundamental elements of the earth's surface should give the pupil a sound and thorough basis for all future knowledge which he may acquire, either during or after his school days, about the earth and all that happens thereon.

In accordance with sound pedagogical principles, the broader physical facts are first treated, so that an outline of the subject is built up in the pupil's mind, to be filled in later by more specific details when each region is taken up in its turn. Here it is gratifying to see that the author has kept closely in touch with the most recent scientific studies upon the form and development of the land surface. It is exceptional to find a geography that recognizes so fully the changes in the land surface by wear (Lesson 11), or the rise of the sea floor to become new land (Lesson 18), or the growth and relative age of mountain ranges (Lessons 19, 77, 89), or the work of the North American ice sheet during the glacial epoch (Lesson 45). The appearance also of such current scientific phrases as 'drowned valley,' 'distributary,' 'drumlin,' 'fiord,' 'alluvial fan,' etc., is another mark of the recognition of the labors of modern scientific geographers.

The illustrations and maps, which in any geography are quite as important an educational element as the text itself, are numerous, closely connected with the text, and for the most part carefully executed and well arranged. Most of the pictures are engraved directly from photographs, a sure means of securing truthfulness. The numerous little globe maps will commend themselves for the views that they give of the relations of the continents and oceans. The usefulness of such a map as that on page 102, however, where the earth's crust is as it were peeled off from the hidden side, and bent around so as to bring all the lands into view at once, may be questioned. The curved distortion necessarily resulting is such as to make the earth here appear neither flat nor round. Such features as this map illustrates, are better shown upon Mercator maps, which, of course, are distorted, but in a manner simple and easily understood. The clearness and simplicity of the study maps throughout the book is worthy of mention, as is also the presence of an entirely separate, large collection of reference maps, abounding in detail, at the end of the book.

The book, of course, is not without its defects. The useful system of cross-references contains some misprints, which escaped notice in the final revision; and in the reference-maps we observe the omission of so noted a volcano as Krakatoa, the insertion of the long-since ruined and abandoned Chenango canal (N. Y.), and the failure to distinguish the political boundaries of Russia from the conventional limits of Europe, where the two happen not to coincide. A good index would be a valuable addition.

The meagre and almost purely categorical treatment of many countries in the latter part of the book is also disappointing. Their physical features are well set forth in the first part, and many facts of interest are mentioned in connection therewith; but in the second part, which deals expressly with political and industrial geography, we regret to see Italy dismissed with but ninety-two words, Greece with but nineteen, and the governments, cities, people, customs and industries of many other foreign countries treated with similar inadequacy. But the book already exceeds the size of the average grammar school geography by more than fifty pages, and the necessary limits to the size of such a book are evident. Such matter might, of course, be supplied by the use of supplementary geographical reading, or by the teacher; but, unfortunately, few schools have the access to good libraries which will make the former possible; and few teachers have a sufficient fund of general information to enable them to supply this need.

To use this book, with all its excellent features, as it should be used to reap the full benefit of its contents, calls for a degree of skill and ability on the part of our teachers beyond that of the average instructor; and school superintendents in places which have adopted it will find it no easy task to educate their teachers to this end. But as the book sets before us a higher standard and ideal of geographical teaching than our schools have ever known before, and as it tends to bring them into closer relations with the best scientific work of the day, it deserves a hearty welcome.

T. W. HARRIS,
KEENE, N. H. *Supt. of Schools.*

The Religions of India. By EDWARD W. HOPKINS. Boston, Ginn & Co. 1895. 1 vol., 8vo., pp. 612.

The Teaching of the Vedas; what light does it throw on the Origin and Development of Religion? By MAURICE PHILLIPS. London, 1895. 1 vol. 8vo.

Of these two books, apearing almost simultaneously, the first mentioned is much the more important in scope and scholarship. It is volume I. of the 'Handbooks on the History of Religions,' edited by Dr. Morris Jastrow, Jr., of the University of Pennsylvania, and its author is Professor of Sanscrit in Yale College.

The plan of his work may be briefly stated. He begins with an examination of the date of the oldest Vedas, reaching the conclusion that the bulk of the Rig Veda was composed about a thousand years before the Christian Era. This is a late date to assign it, and we are inclined to believe that the author has been too much influenced by a certain French school who have set themselves to modernize everything ancient by one-sided arguments. A chapter follows devoted to the ethnography of India, illustrated by a map. The leading questions are touched lightly, dates of monuments are not attempted, and the main points averred are the close relationship of the Vedic Aryans to the Iranians, the entrance of the early hordes through the open pass of Herat, and the existence of castes among them before their settlement in India.

Four chapters are assigned to an exposition of the pantheon of the Rig Veda, and one to the religion of the Atharva Veda, which are followed by a careful and clear comparison (Chap. VIII.) of the early Hindu divinities with those of other Aryan and some non-Aryan peoples. From the Vedic epoch the Indian religions rapidly assumed varied forms. Earliest of these was Brahmanism, which is described in three chapters, followed by Jainism, Buddhism, and the numerous early and late sects of Hinduism, with the worship of Vishnu, Siva and the wild polytheism of later centuries. These are depicted in their chief traits and their historic connections pointed out with learning and clearness. The chapter on the religious traits of the present wild tribes is less satisfactory. Their faiths do not seem to be so familiar to the author, or he has less sympathy and less patience with them. The volume closes with a discussion of the probable influence which Indian religion and philosophy exerted on the analogous mental products of the early Semites and Aryans. It is natural that the author, steeped in the lore of Indian thought, should discover traces of it in the teachings of Jew and Greek; but it is likely that many will think he goes too far in deriving so much of the latter from the former.

It is a question of great moment to the historian of religions whether this long period of continued growth—at least three thousand years—developed in India higher conceptions of divinity and duty, a finer spirituality in the votary, a nobler sentiment toward his fellow man.

On this Prof. Hopkins speaks with clear conviction. He believes that tracing back the numerous branches of Hindu sectarianism to the Vedic period, one finds that throughout the long intervening time the direction has been true, and the higher aim 'steadily kept in view.' "Nor can one judge otherwise even when he stands before so humiliating an exhibition of groundling bigotry as is presented by some of the religious sects of the present day" (p. 472).

In striking contrast to this is the conclusion reached by Mr. Phillips in his volume. In fact, the whole of it seems to be written for the purpose of proving the opposite opinion. He asserts that the farther back we go in the Vedic age, the purer and higher do we find the conceptions of divinity, man, duty, worship, a future state, sacrifice, etc. Hence he avers: "The development of religious thought in India has been uniformly downward—not upward—deterioration and not evolution." He explains this by the theory of a 'primitive divine revelation' granted to the Aryan forefathers, darkened and lost in their descendants. He shows a good reading knowledge of the Vedas in his discussions, but a total ignorance of the methods which now obtain among real scholars in treating the historical growth of religious phenomena. The need of such a work as that of Prof. Hopkins and of the series which it commences, is amply indicated by the appearance of such an essay as that of Mr. Phillips. D. G. BRINTON.

SCIENTIFIC JOURNALS.

THE AMERICAN JOURNAL OF SCIENCE.

THE February number of the American Journal of Science opens with an article by A. M. Mayer, giving the results of an extended series of experiments upon the modulus of elasticity of bars of various metals and its variation with change of temperature. This modulus was obtained by transverse vibrations of bars of known dimensions and density. Rods of steel, aluminum, brass, glass and American white pine were employed. These were vibrated longitudinally, held between the thumb and forefinger, and the vibration-frequencies determined by the help of the standard forks of Dr. Koenig's tonometer in Paris. The application of Poisson's formula (shown to hold closely true by special experiments) gave the velocity of sound, and the modulus of elasticity was then calculated from the usual mathematical relation connecting these quantities. Special experiments were employed to give the coefficients of expansion, the densities, etc. The results are contained in an extended table and further represented graphically in a series of plates. These show that the decrease of the modulus of elasticity of glass, aluminum and brass is proportional to the increase of temperature; straight lines referred to coördinates giving the results of experiments on these substances. The five steels, silver and zinc give curves, convex upwards, showing that the modulus decreases more rapidly than the increment of temperature; while bell metal alone gives a curve which is concave upwards; its modulus decreasing less than the increment of temperature. Bell metal was found to be an alloy peculiarly well suited for bells, as the intensity and duration of its vibration were the same at 50° as at 0°; all other substances showing a marked diminution of intensity and duration of sound at 50°.

In a special discussion as to the acoustical properties of aluminum, it is shown that this metal is not peculiarly *sonorous* as ordinarily believed. On the contrary, if a bar of aluminum and a bar of brass having the same length and breadth and giving the same note are struck transversely so that the bars have the same amplitude of vibration, the bars give equal intensity of sounds; but the bar of aluminum from its low density and because of its internal friction will vibrate less than one-third as long as the bar of brass. The peculiarity of aluminum consists in this fact, that its unusually low density (2·7), combined with a modulus of elasticity of only 712×10^6, renders this metal easy to set in vibration; a transverse blow given to a bar of this metal causes it to vibrate with an amplitude of vibration greater than that which the same energy of blow would have given to a similar bar of steel or of brass.

It is true, however, that since aluminum gives, from a comparatively slight blow, a great initial vibration, and since its vibrations last for a short time, this metal is peculiarly well suited for the construction of those musical instruments formed of bars which are sounded by percussion and the duration of whose sounds is not desirable.

On the other hand, there is one serious objection to the use of aluminum in the construction of musical and acoustical instruments, and that is the great effect that the change of temperature has upon its elasticity. If a bar of aluminum and a bar of cast steel be tuned at a certain temperature to exact unison, a change from that temperature will affect the frequency of vibration of the aluminum bar $2\frac{1}{2}$ times as much as the same change of temperature will affect the bar of cast steel.

A second physical article by Carl Barus gives the results of experiments carried on, with the aid of a fund from the Smithsonian Institution, on the curl aneroid. The special object of the investigation was to find what degree of constancy and precision could be obtained from a suitably modified Bourdon tube, or flattened tube coiled in the form of a helix. A similar tube had been used before successfully for high pressures with, however, certain limitations which do not exist in the case of low pressures, for which it is now designed, *e. g.*, when exhausted for use as an aneroid in registering small changes of atmospheric pressure. Experiments with simple curls are detailed, made very thin by dissolving away the walls in acid. Also other experiments with a counter-twisted system; that is, one supplied with a coiled spring placed above and opposed to the flattened and exhausted curl. The results of the experiments with this form show that by it the hurtful effects of viscosity and changes of temperature can be reduced to a minimum, while the sensitiveness of the instrument is increased to a remarkable degree. G. W. Littlehales discusses from a mathematical standpoint the problem of finding an isolated shoal in the open sea which had been located by previous observation. He concludes that, under certain conditions named, there would be one chance in 6,173 of finding it. This explains why navigators often fail to find shoals shown on their charts. H. B. Kümmel gives a note on the glaciation of Pocono Knob (Monroe county) and Mounts Ararat and Sugar Loaf (Wayne county), in Pennsylvania, which have hitherto been regarded as having risen above the ice during glacial times. The author's observations, however, lead him to conclude that the ice probably covered the highest points of all these summits. T. L. Walker gives the result of a study of crystals of the platinum arsenide, sperrylite, from Algoma, Ontario. He also adds some notes as to its occurrence, and notes the presence of iridium and osmium in the matte from the Murray mines, leading to the conclusion that these metals are sometimes constituents of the sperrylite. S. L. Penfield and E. H. Forbes describe the results of an investigation of the optical properties of the members of the chrysolite group of minerals as connected with their chemical composition. It is shown that the mean index of refraction, and also the strength of the double refraction, diminish with decrease in percentage of iron protoxide, FeO; on the other hand, the value of the optic axial angle (2V) increases. With the FeO about 12 per cent., 2V for yellow equals nearly 90°. Chrysolites containing less than 12 per cent. FeO have the crystallographic axis a for the acute bisectrix and are optically positive with dispersion $\rho < v$, and those richer in iron are optically negative with dispersion $\rho > v$.

The concluding twenty-five pages of the number are occupied with abstracts of papers in other journals, notices of books, scientific news, etc.

ASTROPHYSICAL JOURNAL, JANUARY.

Action of the Editorial Board of the Astrophysical Journal with Regard to Standards in Astrophysics and Spectroscopy.

The board of editors, who have had the question under consideration for the past year, have adopted for the magazine the following standards:

The *Rowland scale of wave-lengths*, the unit of wave-length to be Ångström's, the ten millionth of a millimeter, known also as the 'tenthmeter.'

The *kilometer* as the unit of measurements of motion in the line of sight.

The hydrogen lines to be designated Hα, Hβ, etc., beginning at the red end and continuing through the entire series. Maps of spectra will be printed with the red end on the right, and tables of wave-lengths with the shorter wavelengths at the top.

The hope is expressed that the action of the editors will be concurred in by other astronomers and physicists, and adopted in their publications.

On the Spectrum of Clèveite Gas: C. RUNGE and F. PASCHEN.

The complete results of the writers' investigations are now published for the first time. Tables of wave-lengths and of double lines are given in full. When separated into six series, the lines show a striking regularity. Apparently there are two pairs of these series, each pair approaching a limit common to its components. From this and other reasons it is concluded that the gas consists of two elements, for the lighter of which the name Parhelium has been adopted. The hypothesis of two constituents is strengthened by the fact that vacuum tubes can be made which show the helium series much less brightly without a corresponding decrease of intensity in the parhelium series. Moreover, in the spectrum of the sun's limb the stronger of the helium lines are, according to Young, always seen, those of parhelium only about once in four times.

On the Gases obtained from Uraninite: J. NORMAN LOCKYER.

A paper read before the Royal Society containing some notes on the new gases recently obtained. These notes consist largely of comparisons of the spectra of these gases with those of the Sun and stars.

Outline of an Electrical Theory of Comets' Tails: REGINALD A. FESSENDEN.

The writer advances the theory that a comet's tail consists of negatively charged carbon particles driven from the nucleus by the action of the ultra-violet light of the Sun, its shape being the resultant of four forces: Gravitation acting towards the Sun, electric repulsion of the negative charge on the Sun, attraction due to the positive charge on the comet's nucleus, electrostatic repulsion existing between each negatively charged particle. The varied cometary phenomena are then examined in the light of this theory.

Photographic and Visual Observations of Holmes' Comet: E. E. BARNARD.

This is a résumé of observations made in 1892–93. The frontispiece is an enlargement of a photograph of the comet made soon after its discovery.

The Modern Spectroscope, XV.: F. L. O. WADSWORTH.

In this number of the series is suggested a form of mounting for the concave grating that will overcome its astigmatism so disadvantageous to certain forms of astrophysical work.

Minor Contributions and Notes.

Recent Researches Bearing on the Determination of Wave-lengths in the Infra-red Spectrum: JAMES E. KEELER.

Harvard College Observatory, Circular No. 3: EDWARD C. PICKERING.

THE PHYSICAL REVIEW, VOL. III., NO. 4., JANUARY–FEBRUARY, 1896.

On the Photometry of Differently Colored Lights, and the 'Flicker Photometer:' By F. B. WHITMAN. Based upon the peculiar effect of a flickering light upon the eye (discovered by Prof. Rood), Prof. Whitman has devised a new form of photometer for comparing the luminosities of colored lights and pigments. The construction of the instrument is briefly as follows: The colored surface to be studied is mounted obliquely upon a photometer carriage, and is illuminated from a source of light at one end of the bar. On the same carriage is mounted a white disk receiving light from the other end of the bar, and so arranged that it can be rapidly rotated. This disk is given such a shape that it hides the colored surface during half of each revolution. The eye of the observer thus receives light alternately from the colored surface and the rotating disk, and at low speeds there is a disagreeable flickering sensation. At high speeds the flickering is no longer noticed; strangely enough the sensation of color practically disappears at the same time, so that it is sometimes found impossible to tell what color is being experimented with. When the speed is sufficiently great the instrument can thus be used as an ordinary photometer, and makes possible a comparison of luminosities without annoyance from color differences.

Prof. Whitman describes a number of experiments which were made in order to test the instrument, and finds it much more reliable than the ordinary types of photometers.

The Chemical Potential of the Metals: By W. D. BANCROFT. This paper is devoted especially to a discussion of the experimental data which have a bearing upon Nernst's theory of the E. M. F. of a voltaic cell. Dr. Bancroft is inclined to look upon certain aspects of this theory with considerable distrust. His conclusions may be summed up as follows:

1. The potential difference between a metal and an electrolyte is not a function of the concentration of the salt solution, nor of the nature of the positive ion, except in certain special cases.

2. It is a function of the electrode, of the negative ion, and of the solvent.

3. In aqueous solutions the potential difference is the sum of the term due to the electrode and the term due to the negative ion in the normal cases.

4. For most metals in most electrolytes the term due to the negative ion has the same numerical value and the same sign.

The tables accompanying this article, in which are collected the results of some ten different observers, will be found of especial value.

On the Freezing Points of Dilute Aqueous Solutions: By E. H. LOOMIS. The phenomenon of the lowering of the freezing point of a liquid by the presence of a dissolved salt has so important a bearing upon the theory of solutions that innumerable experimenters have made it a subject of study. That such determinations are extremely liable to serious error is shown by the disagreement between the results of different observers. In some previous work on this subject Dr. Loomis was led to make several improvements in methods and apparatus. The present paper gives the results of his new methods in the case of certain electrolytes, the salts studied being principally chlorides, carbonates and nitrates. In general the results may be said to be in fair agreement with the theory of electrolytic dissociation. With KCl and K_2SO_4 the agreement is complete. With half a dozen other salts it is not so good, but fairly satisfactory. K_2CO_3 and Na_2CO_3 show considerable discrepancies, which, however, may be due to uncertainty in the determination of the conductivities of these salts.

Dr. Loomis devotes considerable time to a discussion of the probable accuracy of his results, and in a minor article in the same number of the *Review* answers certain objections which have been raised against his earlier determinations.

A Comparison of two Concave Rowland Gratings: By ALICE H. BRUÈRE. Miss Bruère subjects the well-known irregularities in the intensity of the different spectra from a concave grating to a careful photometric study. The results show the same general character as those reached by Paschen by bolometric methods. The curves which accompany Miss Bruère's article show in a most striking manner the irregularities in intensity in different parts of the same spectrum, as well as in the spectra of different orders.

A New Apparatus for the Study of Color Phenomena: By E. R. VON NARDROFF. Mr. von Nardroff describes an ingenious apparatus to be used with a lantern for conveniently showing the various experiments dealing with color mixing, contrast, complementary colors, etc. The apparatus has been used by Mr. von Nardroff for several years and found satisfactory and convenient.

On a New Form of Water Battery: By L. W. AUSTIN and C. B. THWING. The writers have devised a cell which is constructed out of a homeopathic vial and strips of sheet copper and zinc, and which appears to possess considerable advantages. The chief novelty consists in the form of the two electrodes. Ease of construction, convenience in filling, and permanence of action are the advantages urged.

Books Reviewed: Daniell, Principles of Physics; Whetham, Solution and Electrolysis; S. P. Thompson, Polyphaze Currents; Palaz, Industrial Photometry; Walter, Oberflächenfarben; Clerke, The Herschels and Modern Astronomy.

SOCIETIES AND ACADEMIES.

JOINT COMMISSION OF THE SCIENTIFIC SOCIETIES OF WASHINGTON.

THE memorial meeting held by the Scientific Societies of Washington, on Wednesday evening, January 14th, at which addresses were made in honor of Dana, Pasteur, von Helmholtz and Huxley, was followed on the following evening, the 15th, by a meeting of the Joint Commission, in honor of the late Charles V. Riley, the entomologist. The memorial address by

Dr. G. Brown Goode will be published in this journal.

At this meeting the Joint Committee elected officers for the ensuing year, with the following result:

President—Gardiner G. Hubbard.

Vice-President—G. Brown Goode.

Secretary—Joseph Stanley-Brown.

Treasurer—Perry B. Pierce.

The Executive Committee elected will consist of the above and one member from each of the component societies, as follows: Anthropological, L. F. Ward; Biological, Dr. George M. Sternberg, U. S. A.; Chemical, Dr. E. A. De Schweinitz; Entomological, Wm. H. Ashmead; Geological, S. F. Emmons; National Geographic, G. K. Gilbert, and Philosophical, Prof. F. W. Clarke.

W. F. MORSELL.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON, JANUARY 4.

E. D. PRESTON read a paper on a new graphic method of reducing stars from mean to apparent places, which gave detailed exposition of a new graphical method of finding the apparent places of stars. The reduction was carried out by having the day numbers plotted on a scale sufficiently large to read two decimal places, and then multiplying these graphically by the star numbers which are calculated by construction on the same sheet. The calculation of these last quantities is facilitated in several ways. Two quadrants are drawn, and the right ascension and declination of the star to be reduced being selected, the simple trigonometrical functions are immediately read off from the figure.

For those terms where a product of functions appears, the method enables the operator to construct the quantity by different processes. That one is chosen which arrives at a resulting line lying at right angles to the day numbers already plotted. This makes their multiplication a very easy matter. In actual practice the construction lines shown on the diagram are of course not drawn. The whole sheet being divided into small squares, the computer is able to project the point visually, and to determine the intersections of the necessary constructions without actually drawing them.

The method has been principally used for checking the regular computation, and this can be done in less than one-half the time required to make the first reduction. But with a scale sufficiently enlarged there seems to be no reason why the system should not be used with entire success for a complete and separate solution.

January 18th the following papers were read: Dr. G. Brown Goode, on 'The Principles of Museum Administration;' Mr. Isaac Winston, on the 'Present form of precise levelling apparatus in use by the U. S. Coast and Geodetic Survey;' Mr. G. R. Putnam, on the 'Results of Recent Pendulum Observations.'

BERNARD R. GREEN,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON, 83D REGULAR MEETING, THURSDAY, NOVEMBER 14, 1895.

THE President, Chas. E. Munroe, in the chair, with thirty-five members present. The following were elected to membership: H. B. Hodges, Allan Wade Dow, W. W. Skinner and F. B. Bomberger. Dr. Marcus Benjamin read a paper on 'The Smithsonian Institution's Contributions to Chemistry from 1846 to 1896.' He referred to the fact that Smithson in his time was considered as among the most expert of chemists in elegant analysis. This he thought had much to do with the provision made for a chemical laboratory in the original 'programme of organization of the Smithsonian Institution.' He traced the history of the laboratory, mentioning the chemists who have occupied it, among whom was J. Laurence Smith. The chemical publications of the Institution were reviewed, beginning with that of Dr. Robert Hare 'On the Explosiveness of Nitre,' in 1850, down to that 'On the Density of Oxygen and Hydrogen, and on the Reduction of their Atomic Weights,' by Edward N. Morley, in 1895. The lectures by Cooke, Johnson, Hunt and others were mentioned and the grants of funds to Genth, Gibbs and Morley for chemical research were described.

The work of Booth as shown in his 'Report of Recent Instruments in the Chemical Arts;' of Clarke in his 'Constants of Nature,' and of Bolton in his 'Bibliography of Chemistry,' as well as the many indexes to chemical literature by Magee, Bolton, Traphagen, Tuckerman and others were mentioned and discussed. The paper was concluded with a full bibliography of the chemical papers published by the Smithsonian Institution.

Mr. Cabell Whitehead read some 'Notes on a recent visit to European Mints.' In the discussion of this paper mention was made of the explosions that occur commonly in lighting a 'Buffalo Dental Company's' muffler furnace, and Mr. Dewey said they could be avoided by raising the whole body of the furnace by a simple arrangement of movable levers and then slipping a lighted paper over the burners.

Under the title 'Calcium Phosphide,' Prof. Chas. E. Munroe described the process of manufacture which he invented and carried into operation at the United States Naval Torpedo Station in 1891. The novelty consisted in the use of the iron crucibles, in which quicklime was heated to redness, after which sticks of white phosphorus were added through an iron tube which penetrated the cover. The process was so simple that eventually it was carried on by unskilled laborers, and the phosphide which was then selling in the market for $2.25 per lb. was produced at a cost of 20 cents per lb. It was manufactured for use in Automobile torpedoes while at practice, and was found so efficient that when a pound in its container was submerged in 18 feet of water it gave a flame 2 feet in height on the surface, which continued to burn for three hours.

A. C. PEALE,
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met December 18; one hundred and six persons present.

Mr. F. W. Crosby described a remarkable locality in Cephalonia where the water runs from the sea into the land at a rate varying from 4,000 to 10,000 cubic feet per minute. This immense quantity of water is utilized as power for mills, but what becomes of it is not known.

Prof. G. Frederick Wright discussed the present status of Glacial man in America. He showed an ancient chipped knife found by Mr. Huston at Brilliant, Ohio, and gave additional evidence, the result of a renewed study upon the ground, to prove that the implement was not intrusive but was found in the undisturbed strata of the original terrace. Prof. Wright's paper was illustrated by a series of lantern slides.

Prof. H. W. Haynes reviewed the evidence of early man in America as presented by Mr. Upham and Miss Babbitt, and showed some of the rudely flaked quartzes found by Miss Babbitt, at Little Falls, Minn.

SAMUEL HENSHAW,
Secretary.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, JANUARY 7, 1896.

Some occurrences of Eruptive Granite in the Archean Highlands of New Jersey: By J. E. WOLFF.

Occurrences of eruptive granite have been described in the white limestone area from Franklin northeastward, to which the present crystalline condition of the limestone is ascribed as due to contact metamorphism. These occurrences lie in the valley at the west base of the Highlands. The object of this communication was to describe the occurrence of a large area of granite within the area of the gneisses themselves, lying near the west edge of the plateau formed by the Archean gneisses and nearly due east of Franklin. The area so far as determined is about six miles from north to south and two miles wide; the field evidence seems to prove its eruptive character through the bounding gneisses.

JANUARY 14, 1896.

1. *National Concentration of Ore Deposits:* By A. C. LANE. (To be published in the Engineering and Mining Journal.)
2. *Plains of Marine and Subaërial Denudation:* By W. M. DAVIS. (To be published in Bulletin of the Geological Society of America.)

T. A. JAGGAR, JR.,
Recording Secretary.

TORREY BOTANICAL CLUB.

THE annual meeting of the Torrey Botanical Club was held on Tuesday evening, January

14th. The reports of the officers and committees exhibited the most flourishing condition in the history of the Club. The following officers were elected for the ensuing year: President, Hon. Addison Brown; Vice-Presidents, T. F. Allen, M. D., and L. H. Lighthipe; Recording Secretary, Henry H. Rusby, M. D., College of Pharmacy, New York City; Corresponding Secretary, John K. Small, Columbia College, New York City; Treasurer, Henry Ogden, 11 Pine Street, New York City; Editor, N. L. Britton, Ph. D., Columbia College, New York City; Associate Editors, Emily L. Gregory, Ph. D., Anna Murray Vail, Arthur Hollick, Ph. B., Byron D. Halsted, Sc. D., A. A. Heller; Curator, Helen M. Ingersoll; Librarian, Wm. E. Wheelock, M. D.

The scientific paper of the evening, by Miss Alice M. Isaacs and Miss Marian Satterlee, and read by Miss Isaacs, was on the 'Anatomy of the Leaf of Solidago Pauciflosculosa.' The study had been suggested by Prof. Britton in order to throw light upon the generic position of the plant, a subject involved in some doubt.

The leaf was compared with that of the typical dicotyledonous plant and with other members of the genus Solidago. The points of difference noted are as follows: 1st, an unusual surface whose punctate appearance is caused by an irregular development of the parenchymatous tissue; 2d, the absence of palisade tissue characteristic of a dicotyledonous leaf. The depressions in the surface are found to be caused by the fact that the leaf is contracted just above and below the bundles, scarcely any mesophyll being found between the bundles and the epidermis. The blade expands between the bundles, and in these expanded parts the mesophyll is found. The epidermis following the outline of the leaf may be cut off in small patches instead of in a continuous piece as is usually the case.

Of the many species examined, Solidago sempervirens was the only one that at all resembled S. pauciflosculosa. The fact that S. pauciflosculosa is a shrubby plant, together with these leaf peculiarities, seem almost sufficient to justify Nuttall in classing this plant as a separate genus Chrysoma.

H. H. RUSBY,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of January 20, 1896, 23 persons present, Mr. C. H. Thompson exhibited specimens of a number of Lemnaceæ, and gave in detail the results of some recent studies which he had made on Wolffia gladiata, var. Floridana, from the sluggish streams of southeastern Missouri, and Wolffia lingulata, which he had collected in Kern county, California, last autumn. Both species belong to the subgenus Wolffiella, of which flowers and fruit are quite unknown. The species found in southern Missouri occurs associated with Leitneria and other distinctively Floridan forms, of which it is one, while the species collected in California seems to have been known heretofore only from central Mexico.

Prof. E. A. Engler, in continuation of his remarks at the last meeting, spoke of certain properties of the parabola, from which it resulted that from any point on the convex side of the evolute of a parabola three normals can be drawn to the latter; from any point on the evolute, two; and from any point on the concave side of the evolute, one. Suggestion was made of the probable bearing of this demonstration on other curves.

Dr. A. C. Bernays exhibited a slide of the epidermis of Fritillaria, exhibiting karyokinetic patterns.

WILLIAM TRELEASE,
Recording Secretary.

NEW BOOKS.

Die Chemie in Taglichen Leben. DR. LASSAR COHN. Hamburg & Leipzig, Leopold Voss. 1896. Pp. vii.+258. M. 4.

Chemistry for Engineers and Manufacturers. BETRAM BLOUNT and A. T. BLOXAM. London, Charles Griffin & Co.; Philadelphia, J. B. Lippincott Co. 1896. $3.50.

Chemical Experiments. R. P. WILLIAMS. Boston and London, Ginn & Co. 1895. Pp. x. +102.

Die Spectralanalyse. JOHN LANDAUER. Braunschweig. Friedrich Vieweg & Sohn. 1896. Pp. 174.

The Child and Childhood in Folk Thought. ALEXANDER FRANCIS CHAMBERLAIN. New York and London, Macmillan & Co. 1896. Pp. x.+464. $3.00.

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*MEMORIAL ADDRESSES BEFORE THE SCIENTIFIC SOCIETIES OF WASHINGTON.**

JAMES DWIGHT DANA.

I HAVE a profound reverence and love for the memory of Dana. Nearly a quarter of a century ago, when I had returned from an exploring expedition in the plateau province, I prepared an article for the *Journal of Science* setting forth some of the characteristics of that land, especially the great blocks into which it is broken by faults and the tilting and wearing of these blocks into plateaus. In that article I characterized the faults, as such were then unknown. On sending the article Dana wrote me a long letter which led to a correspondence and an interview. The geology of arid lands is more easily read than that of humid lands, and Dana remonstrated with me about my conclusions, not deeming it possible to discover such faulting on an exploring expedition, especially as it is on a gigantic scale. Finally I visited him in New Haven, taking with me a series of sections, a body of notes and many photographs, all of which we discussed somewhat in detail. From that time Dana became my adviser and

*Given on January 14th, at a joint meeting of the Societies under the auspices of the joint commission. The address 'On Huxley and his Work' by Dr. Theo. Gill, and the address given the following evening by Dr. G. Brown Goode. 'A Memorial Appreciation of Charles Valentine Riley' will be printed in this journal.

friend, and I owe much to his wisdom and sympathetic assistance. It is thus that a feeling of gratitude impels me to render tribute to his genius.

Dana's time fell in America's first epoch of scientific research. There had been investigation in America before this time, but in the earlier part of the century there sprung up a group of scientific men born on the continent who took a prominent part in the creation of the world's stock of knowledge and who practically organized the scientific cult of America. In this brief account I cannot name all of these men, and yet I will mention ten as the leaders who, with a host of associates, inaugurated a movement which has vigorously grown to the present time and which will continue while civilization lasts. These great leaders were Henry, Logan, W. B. Rogers, Bache, H. D. Rogers, Gray, Hall, Dana, Leidy and Baird.

It must be remembered that the development of science is the work of many men, and that which one accomplishes is but a small integral part of the whole. But these men as leaders of the host established American science upon an enduring basis. The first phases of science are always ephemeral. Before scientific principles are wrought into a permanent form they must be rendered into philosophy. While many men gather the materials, the far-seeing few whose horizon is world-wide must ultimately be the master builders of philosophy.

Among the illustrious men whom I have mentioned, Dana was preëminently the philosopher. He was the man who formulated definitions, axioms and laws which are the fundamental elements of scientific philosophy. The facts must be gathered, and all honor to him who labors in the harvest field of science and adds to the inventory of significant facts; but the masters of science do more, for they organize the facts of science into a living philosophy. Science is not an architectural structure with foundation walls and dome; it is an organic living structure that develops by processes of metabolism. The facts are the constituents of the universal environment and the elements of which philosophy is constructed, and they pour into its living form to be assimilated, to play their part, and that which is perennial is the system of principles which includes all facts.

The life of James Dwight Dana exhibits a well-rounded half century of scientific investigation. For more than fifty years he was actively engaged in research, and for more than fifty years a stream of contributions to science issued from the well-spring of his genius.

For fifty years Dana was one of the editors of the *Journal of Science*, and during that time he was a constant contributor of articles on a wide range of topics, all involving original research. He was probably the best informed man in America in relation to the progress of science, and presented a resumé and criticism of research in many fields which was generous and appreciative on the one hand, far-seeing and profound on the other. Then for more than fifty years he was a professor in Yale College, conducting lectures, guiding classes and training men for scientific research, informing them with the spirit of investigation.

But his editorial and his professorial labors were the fruitage produced by the cultivation of many scientific fields. Instruction and review were always vitalized with research, and nothing came from his brain but living thought. The being of knowledge was transformed into the becoming of knowledge for himself and for the world. Dana was not only a professor and an editor, teaching and recording with wise guidance and profound appreciation, but he was also a zoölogist, a mineralogist and a geologist, and in each of these three realms of science a master. We learn that in his youth, especially while pursuing his college course at Yale, he made a study of the plants of the region as a diligent botanist. This early study was a valuable preparation for his life's work, and its results were exhibited in the use which he made of plants in characterizing geologic periods.

In 1838 he sailed with the Wilkes expedition to explore the Pacific. This great voyage was over the mighty ocean to unknown lands of many climes, and for four years he was allured by strange sights, attracted by diverse objects of nature and thrust into the midst of a vast field of observation.

Here as a naturalist he engaged in the study of marine life, giving especial attention to the zoöphytes and crustacea, and laying the foundations of the knowledge of zoölogy which was afterward woven into the philosophy of the planet. The coral animals are animate builders of continental rocks, but he went beyond the structures which they built to study the builders themselves, their habits and the conditions under which they live. Out in those lonely seas, with savages for assistants, he studied the builders and their constructions, the animals and the atolls, the coral groves and the arboreal denizens, and returned with a vast accumulation of materials. Years were required for their elaboration. With patience this labor was performed, until at last he gave us an account of zoöphytes and also an account of the crustacea, which is in itself a monument worthy of a great man.

From his schoolboy days he pursued mineralogy as a field observer and by mathematical investigation. Early he commenced to publish on this subject, weaving the knowledge of his time into a systematic body, reënforcing his own observations by the observations of all others. Thus he was the first to give us a system of mineralogy; but his work in this field did not end at that stage. He still pursued his investigations, collecting from many fields and drafting from the collections of others in many lands, until at last he developed a new system of mineralogy, placing the science upon an enduring basis. This accomplishment alone was also worthy of a great man, and by it a new science was organized on a mathematical, chemical and physical basis.

Here we see exhibited the integrity of Dana's scientific character. In his first work on chemistry he adopted a system of nomenclature that involved a classification which then seemed to be in harmony with the practices of science, for he adopted a system analogous to that used in zoölogy which he advocated with acuteness, but further investigation revealed to him that his reasoning was wrong, that there was a more natural and scientific method, and he rent the whole fabric of his first work into shreds and rebuilt a new and better system. All honor to the man who can thus sacrifice his consistency to the truth.

While Dana was in the midst of his scientific work, Darwin announced the results of his investigations into the origin of living forms; it was a great stroke of genius. The doctrine which had been suggested and ably advocated by Lamarck was established by an inductive research in wide realms of botany and zoölogy, and new laws of evolution were discovered. But Dana had already propounded a doctrine of serial cephalization for animals, although not fully seizing the principles of evolution; still it was a long step in that direction, and he adjusted his philosophy to the new doctrine, and no great revolution was required. This was generously and thoroughly done.

We have seen Dana as a botanist, a zoölogist and a mineralogist. We are next to see him in the great work of his life, as a geologist. In 1833 he left Yale College, before graduation, to become an instructor to midshipmen on a cruise in the Mediterranean. His first contribution to science was the result of observations made on this cruise; it is entitled 'On the Condition of Vesuvius in July, 1834.' At this early age, therefore, he began the study of volcanoes. While on the exploring expedition in the Pacific he visited the great volcanoes of the Hawaiian Islands. There is on the earth no other such region of fire as that first studied by Dana, and we may say last studied by him, for he revisited the region in his old age. Thus, on the exploring expedition he was introduced to two of the great geological agencies—vulcanism, the most conspicuous, and animal life, no less potent but less obtrusive.

On his return to the United States Dana resumed work in Yale College and continued field explorations in mineralogy and geology. The part of New England which he was led to explore is a region mainly of metamorphic rocks, and as a mineralogist he was especially equipped for such a field. It is also a region of glaciation, and he threw his energies into these two fields, which at that time were obscure. On the one hand he found glaciation interpreted simply as iceberg transportation, and on the other as a universal or almost universal ice period. These theories never led him astray, but with careful and persistent labor he unraveled the problem, and, perhaps more than any other man of his age, succeeded in putting glacial geology upon a sound basis. Equipped as a botanist, deeply versed in zoölogy and a great contributor to knowledge in that department, the leading mineralogist of the world, and no inferior chemist, the geology of the country became his theme, and with it the geology of the planet. At last he formulated a general system of geology, which has become the standard in America. His researches in the field were extensive, but they were reënforced by all the geological workers on the continent and the whole geological literature of Europe. So Dana's geology is not only a text-book of geology, but it is the hand-book for all National, State and local geologists, and all students in the field. It is the universal book of reference in that department of science. Other text-books have been developed, but no other hand-book for America. It is a vast repository of facts, but all arranged in such a manner as to constitute a system of geologic philosophy. It is on every worker's table and is carried in the kit of every field observer. It has thus become the standard to which all scientific research is referred, and on which geologic reports are modeled. Of the ten great men who organized science, five were geologists—Logan, the Rogers brothers, Dana and Hall, who yet remains with us. May he be long in the land!

Dana as a zoölogist was great, Dana as a mineralogist was greater, but Dana as a geologist was greatest, and Dana in all three was a philosopher, hence Dana's great work is enduring.

It thus came about that Dana wrought his work into a systematic body of science. The ruins of ancient towns and cities are widely scattered over all the earth, and the arts there entombed are disinterred as evidences of former culture, but we do not study ancient arts for the sake of imitating them; ancient art never becomes the model for modern art. The tribes and nations of antiquity are themes of investigation, but ancient institutions never become the models for modern institutions. Ancient languages are the themes of study, but never more will ancient languages become the models for modern languages. So ancient opinions are of profound interest, but ancient opinions will never again become the models for modern opinions. We study the past for the history of the past, not as a model to be imitated, but as exhibiting the laws of culture, and by these laws learn to construct a better future. Thus we study the philosophy of the past, not that we may adopt that philosophy, but that we learn the laws of progress and avoid the errors of the past and construct a wiser future.

In the history of philosophy two lessons are plainly taught. The first is that no man can evolve an enduring philosophy from his own thought, but that philosophy must be evolved from facts, for the wrecks of such philosophies are scattered over the pages of thought from the time of Plato to the time of Hegel. The second great lesson is this, that the construction of an enduring philosophy is not the work of one mind, but of a multitude of men who gather their materials by scientific research. Since the days of Aristotle the wrecks of such attempts have strewn the highway of history. Even Descartes failed to do more than to make a contribution, while Newton and Darwin gave us but materials for philosophy, not philosophy itself. A host of men have engaged in this work collecting and organizing materials, and another host yet to live must carry on the work ere a scientific philosophy is developed, while the structures which have hitherto been developed mark but the stages of growth and those philosophies which have been wrought of pure thought; thought not informed by fact, are great lighthouses of warning to guide us from the rocks. It is thus as a philosopher of the scientific school that Dana's name will be remembered and Dana's contributions forever remain.

In a quiet street of the good old town of New Haven, Dana labored far from the turbulent crowd, absorbed in facts of observation and acquisition, loving and loved as only the quiet student can love and be loved. No pageantry marked his life, no glittering honors shed their luster over his career; he built only as the philosopher builds and he lived only as the philosopher lives.

The thoughts of early man are now unknown;
In all the tomes of world no page is his.
The grand phenomena of arching heaven,
The wondrous scenes of widespread earth and sea,
The pleasure sweet and bitter pain of life,
As these are known to-day so were they then,
But all in psychic terms of simple men.

And yet his thoughts live on to later time.
As mind has grown the thoughts have been enlarged,
Revolving oft in human soul through life,
In grand endeavor yet to reach the truth,
Repeated o'er by streams of countless men,
And changing e'er with mind's expanding view,
Till errors old have grown to science new.

With knowledge gained man never is content:
Nor wold, nor mount, nor gorge, nor icy field,
Nor depths of sea, nor heights of starry sky,
Can daunt his courage in this high emprise,
Or sate the vision of his longing eyes.

J. W. POWELL.

PASTEUR.

LADIES AND GENTLEMEN: I am to speak to you of the life and achievements of one who has won imperishable renown by his valuable contributions to human knowledge, and who has recently been buried in the city in which his scientific labors have been prosecuted, with all the honors which it was possible for a grateful people to confer. It is certainly a happy augury for the future when the man of science, whose achievements have been the result of painstaking and laborious work in the laboratory, receives the grateful plaudits of his fellowmen during his life time and the honors which were formerly only paid to civil potentates or military heroes when his body is committed to the tomb. It has been the fortune of few men to contribute so largely to the sum of useful knowledge, and fewer still have lived to receive such ample recognition of the value of their scientific work.

Pasteur's success has been due to a combination of personal qualities which especially fitted him for the pioneer work which he has done in his chosen field of scientific investigation. With that penetrating intellect and versatility of resource which constitutes genius was combined an energy and persistence of purpose, a disregard of accepted theories not supported by evidence, and an appreciation of the value of the experimental method as the only reliable means of arriving at exact truth. No amount of conservative opposition intimidated him when he announced results obtained by his carefully conducted laboratory experiments, and no false pride seduced him into maintaining a position which he had once taken, if the experimental evidence was against him. This rarely happened. But where is the man of science who is infallible? Working in a new field by methods largely of his own devising, which were necessarily more or less imperfect at the outset, it is surpising how few mistakes he made.

With his genius for scientific research, his indomitable perseverance and the forceful character which enabled him to defend his discoveries so successfully, there must have been associated a kindly disposition; for those who were closely associated with him in his laboratory work were devotedly attached to him. He evidently had the faculty of inspiring others with his enthusiasm for science, and their loyalty to him and to their common mistress was rewarded by the frank acknowledgement on his part of their share in the work accomplished. So far as I am aware, he never showed any disposition to appropriate for himself credit due to another, whether that other was an associate or pupil in his own laboratory or one who was prosecuting his investigations elsewhere. The speaker's personal acquaintance with Pasteur is limited to a memorable half day spent in his laboratory about ten years ago. Although still disabled to some extent by paralysis, resulting from his first apoplectic attack, he conducted m through his laboratory, and with the greatest kindness explained to me the methods in use and the results recently accomplished in the lines of experimental work which at that time occupied the attention of himself and his colleagues.

The time at my disposal will permit only a brief review of the life and work of this illustrious savant; but this review will show that his scientific achievements are of the highest order, and that the practical benefits resulting from his labors have extended to all parts of the civilized world. He belongs not alone to France, but to science, and it is eminently fitting that we should pay a tribute to his memory in this capital city of a country in which his name is so well known and in which the results of his scientific investigations are so highly appreciated.

Louis Pasteur was born at Dôle, a small town in the Department of Jura, France, on the 27th of December, 1822; he died at his home in Garches, a suburb of Paris, on the 28th of September of the past year.

Pasteur's father had been a soldier in the army of Napoleon, but at the time of his famous son's birth was working at his trade as a tanner. In 1825 the family moved to Arbois, a small town in the same department, and here Louis Pasteur attended school at the *collège communal.* Later he was sent to the college at Besançon, where he took his degree of the *Bachelier des Lettres.* He subsequently entered the École Normale of Paris, and while there devoted him- to his favorite study—chemistry. Three years after joining the École Normale he was appointed Assistant Professor of Physical Science. In 1848 he was appointed Professor of Physics at Dijon, and after a few months resigned this position for the chair of chemistry in the University of Strassburg. In 1854 Pasteur was induced to accept the position of Dean of the newly created Faculty of Sciences at Lille; and in

1857 he returned to Paris as scientific director of the École Normale, where he had gained his first scientific laurels. In 1862 Pasteur became a member of the Institute and in the same year he was appointed Professor of Geology, Physics and Chemistry in the *École des Beaux Arts.* He was elected to the Academy of Sciences, taking the *fauteuil* of Littré in 1881. The same year he received the Grand Cross of the Legion of Honor. In 1874 the National Assembly of France voted him a life pension of 20,000 francs annually. Upon the anniversary of his 70th birthday, December 27, 1892, he received from his compatriots a superb ovation at the Sorbonne, which was attended by President Carnot, the members of the French Institute, all foreign ministers and ambassadors then at the French capital, and delegates from scientific societies in all parts of the world. The Pasteur Institute, established in his honor, was inaugurated with proper ceremonies on the 14th of November, 1888. It is situated in the *rue Dutot*, Paris, and is an imposing stone building in the style of Louis XIII. It was built and equipped from a fund raised by public subscription amounting to 2,586,000 francs. Of this sum 200,000 francs was voted by the French *Chambres Legislatif.* After the completion and equipment of the building more than 1,000,000 francs remained as a permanent endowment.

The time at my disposal will permit of but a brief review of Pasteur's scientific achivements. After having made some notable discoveries in chemistry his attention was attracted to the minute organisms found in fermenting liquids, and by a brilliant series of experiments he demonstrated the fact that the chemical changes attending fermentation are due to the microscopic plants known as bacteria; also that different species give rise to different kinds of fermentation, as shown by the different products evolved during the process. In prosecuting these studies he discovered the species which produce lactic acid, acetic acid and butyric acid, and he added largely to our knowledge relating to alcoholic fermentation and the class of microörganisms to which it is due. He showed that in the absence of living organisms no putrefaction or fermentation can occur in organic liquids, and that these low organisms do not develop by spontaneous generation, as was at that time generally believed, but have their origin from preëxisting cells of the same species, which are widely distributed in the atmosphere, especially near the surface of the earth. Various experimenters had shown that a development of bacteria sometimes occurs in boiled organic liquids excluded from the air. Pasteur showed that this was not due to spontaneous generation, but to the survival of the spores of certain species of bacteria; these are able to resist a boiling temperature without loss of vitality and reproductive power.

In 1865 the distinguished French chemist, Dumas, invited his former pupil, Pasteur, to make investigations with reference to the cause and prevention of a fatal malady among silkworms, which threatened to destroy the silk industry of France. In the course of an investigation which occupied several years, Pasteur succeeded in demonstrating the nature of the infectious malady known as *pébrine*, the mode of its transmission, and the measures necessary to eradicate it. Following his advice the growers of silkworms succeeded in banishing the scourge, and within a few years the industry was reëstablished upon its former profitable footing.

This pioneer work led to further investigations with reference to the cause and prevention of certain infectious diseases of the lower animals, and especially to the fatal disease of cattle and sheep known as anthrax. Having satisfied himself that this disease is due to a bacillus, which is found in great numbers in the blood of infected animals, he demonstrated by experiment that this bacillus rapidly loses its virulence when cultivated in artificial media at a temperature of 42° to 43° C.; also that animals inoculated with this 'attenuated' virus suffer a mild attack of the disease, and that after their recovery they are immune against future attacks, even when inoculated with the most virulent material. This discovery has been applied practically, on an extensive scale, in France, Austria, Switzerland and other European countries. The result of anthrax inoculations made by Pasteur's method in France during the past twelve years was summarized by Chamberland in 1894. He reports the total number of animals inoculated during this period as 1,788,677 sheep and 200,962 cattle; and estimates the total saving as the result of the inoculations as 5,000,000 francs for sheep and 2,000,000 francs for cattle.

Another infectious disease in which Pasteur's method has been employed with success is *rouget*, or hog erysipelas. Chamberland states that, as a result of the protective inoculations practiced with Pasteur's 'vaccines,' the mortality from this disease in France has been reduced from about 20% to 1.45%. Hutyra reports that during a single year (1889) 48,637 pigs were inoculated with Pasteur's vaccines in Hungary with a loss of 0.29%, while the losses upon the same farms in previous years averaged from 10 to 30%.

But we must pass to that portion of Pasteur's scientific work which has most engaged the attention of the public. Pasteur first announced his success in reproducing hydrophobia in susceptible animals by inoculations of material obtained from the central nervous system, in a communication made to the Academy of Sciences on May 30, 1880. Continuing his investigations, he reported, in 1884, his success in conferring immunity against hydrophobia in 19 dogs inoculated, in the presence of a commission appointed for the purpose, as a test experiment. These animals had been rendered refractory by his method. The 19 protected animals and 19 control animals, obtained from the public pound without any selection, were tested at the same time. The test was made upon some of the animals of both series by inoculation with virulent material upon the surface of the brain, and upon others by allowing them to be bitten by rabid dogs, and upon still others by intravenous inoculations. Not one of the protected animals developed hydrophobia; on the other hand, three of the control animals out of six bitten by a mad dog developed the disease, five out of seven which received intravenous inoculations died of rabies, and five which were trephined and inoculated on the surface of the brain died of the same disease.

With reference to his first inoculations in man, Pasteur says:

"Making use of this method, I had already made fifty dogs of various races and ages immune to rabies, and had not met with a single failure, when, on the 6th of July, quite unexpectedly, three persons, residents of Alsace, presented themselves at my laboratory."

These persons were Theodore Vone, who had been bitten on the arm on July 4th; Joseph Meister, aged nine, bitten on the same day by the same rabid dog; and the mother of Meister, who had not been bitten. The child had been thrown down by the dog and bitten upon the hand, the legs and the thighs, in all in fourteen different places. Pasteur commenced the treatment at once, and had the satisfaction of reporting to the Academy of Sciences in March of the following year (1886) that the boy remained in perfect health. Since this time Pasteur Institutes for the treatment of hydrophobia have been established in all parts of the civilized world, and the statistical reports published justify the belief that when the treatment is instituted at an early date after the bite, and is properly carried out, its protective value is almost absolute. At the Pasteur Institute in Paris 9,433 persons were treated during the years 1886 to 1890, inclusive. The total mortality from hydrophobia among those treated was considerably less than one per cent. (0.61). In 1890 416 persons were treated who had been bitten by animals proved to be rabid, and among these there was not a single death. In 1891 the number of inoculations was 1,539, with a mortality of 0.25%; in 1892, 1,790 with a mortality of 0.22%; in 1893, 1,648 with a mortality of 0.36%; in 1894, 1,387 with a mortality of 0.50%.

There has been and is still a considerable amount of scepticism among members of the medical profession, and others, as to the practical value of Pasteur's inoculations for the prevention of hydrophobia; and some physicians have even contended that the disease known by this name is not the result of infection from the bite of a rabid animal, but is a nervous affection due to fear. The time at my disposal will not permit me to present for your consideration the experimental and clinical evidence upon which I base the assertion that nothing in the domain of science is more thoroughly demonstrated than the fact that there is a specific infectious disease known to us as rabies, or hydrophobia, which may be communicated to man, or from one animal to another, by the bite of a rabid animal; and that Pasteur's inoculations prevent the development of the disease in animals which have been infected by the bite of a rabid animal or by inoculations with infectious material from the central nervous system. This being the case, it is evident that there is a scientific basis for Pasteur's method of prophylaxis as applied to man, and his published statistics give ample evidence of the success of the method as carried out at the Pasteur Institute in Paris and elsewhere. Great as have been the practical results which have already followed Pasteur's brilliant discoveries, there is reason to believe that in the future still more will be accomplished, especially in combatting the infectious diseases of man. Having pointed out the way, a multitude of earnest investigators in various parts of the world are now engaged in laboratory researches relating to the cause, prevention and cure of infectious diseases. Already, in the treatment of diphtheria and of tetanus with blood serum obtained from immune animals, results have been obtained of the highest importance, and it seems probable that in the near future other infectious diseases will be cured by a specific treatment based upon scientific information obtained by those who have been following in the pathway marked out by Pasteur, the illustrious pioneer in this line of research.

GEO. M. STERNBERG.

HELMHOLTZ.

HERMANN LUDWIG FERDINAND, BARON VON HELMHOLTZ, was born at Potsdam on August 31, 1821.

In 1842 he received his decree in medicine at Berlin, and entered the government service as an army surgeon.

In 1847 he published his essay on the Conservation of Energy.

In 1849 he was appointed professor of physiology at Bonn.

In 1851 he invented the Ophthalmoscope.

In 1855 he was made professor of anatomy and physiology at Bonn.

In 1859 he was appointed to the same chair at Heidelberg.

In 1860 he was made one of the foreign members of the Royal Society of London.

In 1863 he published his great work on the 'Sensations of Tone.'

In 1866 the first edition of his 'Physiological Optics' was completed.

In 1871 he was made professor of natural philosophy at the University of Berlin.

In 1873 he received from the Royal Society the highest distinction which it can bestow, the Copley Medal; and in the same year the King of Prussia conferred upon him the Order of Merit in Science and Art.

In 1883 hereditary nobility was conferred upon him by Emperor William I.

In 1887 he assumed the directorship of the great Physico-technical Institute, founded by the German government at Charlottenberg.

In 1891 the seventieth anniversary of his birth was celebrated with great ceremony and he was placed at the head of the civil list by the German Emperor.

In 1893 he visited America, serving as President of the International Electrical Congress held in Chicago.

In 1894, on September 8th, he died at the age of seventy-three years.

Such is the brief outline of the life of one of the most extraordinary men of the present century. To perfect such a sketch in anything like just proportions, or to attempt in the few minutes allotted to me to-night to set forth anything like a fair estimate of the labors of one of whom it may be justly said that he was the most accomplished scholar of modern times, is a task no one would seek. Nor can one easily decline the honor which is carried by an invitation from a commission representing the scientific societies of Washington to take part in so memorable a commemoration as this. Under the circumstances, I must confine myself to an exposition, all too brief, of a few only of the principal contributions to human knowledge among the great number for which the world is indebted to Prof. Helmholtz. It was his distinctive characteristic that among the exponents of modern science he stood quite alone in being really great along several lines. He was in the beginning and always a pure mathematician of high type. Anatomists and physiologists claimed him for their own. During a few days' stay in New York in 1893, after having presided over the International Congress of Electricians, he was entertained by a distinguished surgeon, the leading eye specialist of the country, and ophthalmologists flocked to do him honor as one of the founders of their profession. When, in 1881, he gave the Faraday lecture before the Chemical Society of London, the President of Society in presenting to him the Faraday Metal, declared that eminent as was Helmholtz as an anatomist, a physiologist, a physicist and a mathematician, he was distinctly claimed by the chemists. Nor were these only idle compliments. Only a few days ago I happened on a most curious and interesting illustration of the unequalled extent of his scientific constituency in finding, in a widely known journal published in London, his obituary notice indexed under the heading, 'The Stage and Music,' where his name appeared accompanied by only that of Anton Rubenstein. His great work on the 'Sensations of Tone' and his analysis of the vowel sounds of the human voice gave him a lasting fame among musicians.

Psychology as well as Æsthetics was benefitted by his touch, but I think it will be generally admitted that he was first of all, and more than all else, a physicist. Indeed it may be said that the best fruits of his study of other branches of science grew out of the skill with which he engrafted upon them the methods of investigation for which we are primarily indebted to the physicist.

When a boy he had acquired a fondness for the study of Nature. His father was a professor of literature in the gymnasium at Potsdam; his mother a woman of English descent. Although he was encouraged in the development of his youthful tastes as much as possible, the necessity for earning a living directed his professional studies towards medicine and he became a military surgeon. As a physiologist he was led to the study of 'vital force'; his taste for mathematics and physics forced him to the dynamical point of view, and his first great paper, prepared before he was twenty-six years of age, was on the Conservation of Energy. It is now nearly fifty years since this essay was presented to the Physical Society of Berlin, and doubtless quite fifty years since it was actually worked out. Its excellence is shown by the fact that if rewritten to-day it would be changed only a little in its nomenclature. Fifty years ago the great law of the Conservation of Energy, which will ever be regarded as the most pregnant and far-reaching generalization of this century, was so far from being known or recognized that many of the ablest men of the time either regarded it as a 'fanciful speculation'—or did not regard it at all.

As a matter of ordinary mechanics, it had long been admitted that no machine could create power and, as a part of that applied was always lost or frittered away in friction, the work coming out of a machine must always be less than that put into it. The first great advance had been made by an American, Benjamin Thompson, afterwards Count Rumford, when he asked what became of that part lost in friction and found his answer in the heat generated thereby, thus proving that 'heat was a mode of motion,' 'rather than an imponderable agent,' as it was rather ambiguously designated up to nearly the middle of this century, but that *all* of the forces of nature were so related to each other as to be interconvertible and that the sum total of all the energies of the universe was always the same, energy being no more capable of creation or destruction than matter; these were great facts, mere glimpses of which had been permitted to the physicists of the early part of the century. Helmholtz was certainly one of the first to completely grasp this splendid generalization, and not more than two or three others stand with him in the credit which is due for its complete proof and general acceptance. His first contribution had the merit of being quite original in conception and execution, for he then knew almost nothing of what others had done; he was entirely ignorant of the important paper of his fellow countryman, Mayer, and knew only a little of Joule's earlier work. The principle of the conservation of energy, which for a quarter of a century has been the open-sesame to every important advance in physical science, was not then, to say the least, a popular topic. But for five or six years a young Englishman named Joule, not yet thirty years old, had been engaged with it and, from the point of view of the engineer, had made it his own. On the 28th of April, 1847, he gave a popular lecture in Manchester, where he lived and died, which was the first full exposition of the theory. A few weeks later Helmholtz read his paper in Berlin. In England even the local press refused to publish Joule's address, but finally the *Manchester Courier*, moved by the family influence (the elder Joule being a wealthy brewer), promised to insert the whole, as a special favor. In Germany the subject met with only a little more favorable reception, and the leading scientific journal, *Poggendorff's Annalen*, declined to publish Helmholtz's paper. Even at the meeting of the British Association at Oxford a few months after the Manchester address, when Joule again undertook the exposition of his theory and his experimental proofs of it, before what ought to have been a more friendly audience, he was advised by the Chairman to be brief, and no discussion of his paper was invited. As Joule himself relates, his presentation of the subject would have again proved a failure, 'if a young man had not risen in the section and by his intelligent observations created a lively interest in the new 'theory.' This young man was William Thomson, then twenty-three years old; now, Lord Kelvin, the foremost of living physicists.

The tremendous blows struck by Helmholtz in support of the new doctrine, from that time until it was no longer in the balance give evidence alike of his extraordinary talents and his fine courage. The publication of this important essay in 1847 had also the effect of bringing about an immediate appreciation of his abilities. Du Bois-Reymond gave a copy of it to Tyndall, then a student of Magnus in Berlin, saying that it was the product of the first head in Europe. He was shortly removed to the more favorable environment of a University professorship at Königsburg. During the next twenty years he advanced from Königsburg to Bonn, from Bonn to Heidelberg and from Heidelberg to Berlin. While it was only on reaching the University of Berlin that he assumed his true function of Professor of Physics, yet the previous two decades had been rich in the application of physical methods to physiological subjects.

In 1863 He published the remarkable monograph on the 'Sensations of Tone.' This work is a most masterly analysis of the whole subject implied in its title and must always remain a classic. Only one or two of the most important results of the profound researches of the author can be referred to here. As every one knows, the character of a musical tone is threefold. There is first its pitch, which has long been known to depend upon the frequency of vibration of the string or reed, or whatever gives rise to the sound; there is next the loudness, which depends upon the amplitude of this variation, or, in a general way, on the energy expended by the vibrating body. But two tones may agree in pitch and in loudness and still produce very different impressions on the ear. It is this which makes it possible to know when a musical tone is heard that it comes from an organ, or a flute, or the human voice. It enables an expert to know on hearing a single note from a violin that the instrument was made in a given year by a certain artist; by virtue of this characteristic one instantly recognizes a voice which one has not heard for many years as belonging to a particular individual. So little was known of the physical cause of this inherent peculiarity of a sound that for many years it went unnamed. Helmholtz called it the 'Klangfarbe' literally, 'tone-color;' but in English the term 'quality' is now universally applied to it. What is the physical cause of the quality of a tone? is the question, the answer to which he sought. All that there is in a tone, he said, pitch, intensity and quality, must be borne upon the air-waves by which the sound is communicated to the ear, and all that these waves bear must be impressed upon them by the vibrating body in which the sound originates. He did not fail to recognize, however, and this was extremely important, that there might exist peculiarities in the receiving instrument, the ear (through the operation of whose mechanism the motion of matter is interpreted as a sensation), the existence of which would materially modify the final outcome, to the end that two physically identical tones might give rise, under certain circumstances, to different sensations. Guided by these principles he discovered that the quality of a tone, that characteristic which gives charm to it, was really due to its impurity; that if two perfectly pure tones, generated by simple, pendular vibrations, agreed in pitch and loudness it would be quite impossible to distinguish them. But, practically, such tones are never produced; all ordinary tones are composite, made up of the fundamental, which generally fixes the nominal pitch of the whole, and a series, more or less complete and extended, of overtures or harmonics, the vibration frequencies of which are two, three, four or some other multiple of that of the fundamental. Without these, the fundamental, though pure, was plain, dull and insipid; with them it formed a composite with quality, soft it may be, or brilliant or rich or harsh, or any of the thousand things which may be said of a tone. *Which* it was and *what* it was, was determined by the relative proportions of the several overtones, indefinite in number, in the composite whole. This beautiful hypothesis was illustrated and established by innumerable experiments, and it was proved that the *form of the air wave* was the quality of the tone, and that this form originated in the mode of vibration of the sounding body, which was almost universally not simple, but complex. But the most important work of Helmholtz along this line was the extension of this theory to the solution of a problem more than two thousand years old, proposed, in fact, by the Greek, Pythagoras. It meant nothing less than the physical explanation of harmony. Why are certain combinations of musical tones agreeable and others unpleasant?—and, indeed, the answer to this tells as well, why a certain *succession* of tones, as in a musical scale, is likely to be generally acceptable to the human ear. Lack of time will only permit me to say that in the interference and consequent *beating* of certain of the overtones or upper partials, of two fundamentals, Helmholtz found the explanation of their dissonance, and that while in certain particulars his theory as originally published has been criticised, it is in general universally accepted and admitted to be one of the most splendid contributions to modern science.

I am warned, also, that I must not speak of that other great work, the Physiological Optics, as I would so gladly do if time permitted. Helmholtz was actually engaged in the preparation of this and the 'Sensations of Tone' during the same years. No other man in the world could have written these, for no other was at once an accomplished physiologist, mathematician and physicist. While I cannot speak of his contributions to the science of optics and ophthalmology, I must not omit brief reference to his invention of the ophthalmoscope and the ophthalmometer. Anxious to actually see what goes on in the eye, and especially on the retina, that wonderful screen on which the image of the visible world is focussed, he invented the ophthalmoscope. The qualitative victory was followed by the quantitative, in the invention of the ophthalmometer, by means of which accurate measurements of the various curved surfaces in the eye could be made. These two instruments have been to ophthalmic surgery what the telescope and graduated circle have been to astronomy. So exact has the science of the eye become through their use that it is not great exaggeration to say that one may now have a disordered eye repaired, corrected and set going with little more uncertainty than attends the performance of the same duty for an ill-conditioned chronometer. Had Helmholtz accomplished nothing except the invention of these instruments he would have been entitled to the thanks of all mankind, on account of the comfort they have added to life and the pain and suffering they have prevented.

If I had devoted all of the time allotted to me to a simple enumeration of the contributions to human knowledge made by von Helmholtz during fifty years of marvellous intellectual activity I must have left my task incomplete, but I must not close without reference to one or two of these, more purely physical in their character and equally stamped with the genius of their author.

Perhaps Nature has shown herself most reticent and unyielding when scientific men have questioned her as to the ultimate structure of matter, the full knowledge of which includes a satisfactory explanation of the force of gravity which is one of its essential properties. Hypotheses which have been very useful in their time have been finally rejected because they involved some impossible conception, such as action at a distance, which was for a long time believed possible. The tendency is now and has long been to regard space, or at least that part of it in which we have any particular interest, as a plenum and to assume a continuous, incompressible, frictionless elastic fluid in which and of which all things are. In the development of his exquisite theory of vortex motion, Helmholtz demonstrated the possibility of a portion of such a fluid being differentiated from the rest in virtue of a peculiar motion impressed upon it, and that when so differentiated it must forever remain so, a fact which was quickly seized upon by Lord Kelvin as the foundation of a vortex theory of matter, thus sharing with Helmholtz the honor of having approached nearer than all others to the solution of the great mystery.

From the genesis of an atom to the origin of the universe seems a long step, but it is not too great for the intellect of man. The well-known Nebular Hypothesis was advanced long before Helmholtz's time, but a better knowledge of Thermodynamics had quite upset one of its generally accepted principles, namely, that the original nebulous matter was fiery hot. As long ago as 1854 Helmholtz showed that this was not a necessary assumption and proved that mutual gravitation between the parts of the sun might have generated the heat to which its present high temperature is due. The greatest philosophers of the past hundred years have attempted to account for this high temperature and for its maintenance, on which all life on this globe depends. The simple dynamical theory of Helmholtz has survived all others and is to-day universally accepted.

But I must cut short this absolutely inadequate account of what the scholar did, that I may say a word or two of what the man was. Although one of the most modest and quiet of men, no one could meet him without feeling the charm of his personality. Although he bore a dignity which became the great master of science which he was everywhere admitted to be, he was approachable in an extraordinary degree. He was eloquent in popular address and believed in the obligations of men of science to the general public. In scientific discussion, whether on his feet or with pen in hand, there was a certain massiveness about his style and manner which was generally irresistible. In his attacks upon the region of the unknown he showed possibly less brilliant strategy than one or two of his contemporaries, but he rarely, if ever, found himself obliged to conduct a retreat. In 1893 he was selected by the Emperor as the head of the German delegation, five in number, to the International Electrical Congress held in Chicago in August of that year. His more than three score and ten years weighed upon him, and he begged to be relieved of the duty. The young Kaiser, who was fond of him and who loved to honor him in every way, sent for him. On hearing his modest plea he said, "Helmholtz, you must go; I want the Americans to see the best I have of every kind, and you are our greatest and best man." As becomes a dutiful subject he yielded. While in this country every honor was shown him. Here he found many of the hundreds or thousands of his pupils who everywhere in the world are adding lustre to his name by perpetuating his spirit and his methods, and all were ready to serve him. Electrician, mathematician, physiologist and physicist, he found everywhere a large and appreciative constituency, while his own almost boyish pleasure in whatever he saw that was novel was charming to see. On his homeward voyage he met with an accident which was thought by many to be the beginning of the end. Up to the time of his death, which occurred about a year later, he continued, but not very actively, to direct the great institution for original research, in which, by the wisdom of an appreciative government, he had found full scope for his powers. His interest in the important work done at the Chicago Congress continued through this year, and one of the few long letters he wrote had reference to its proceedings. On the 8th of September, 1894, he died, and on the 13th he was buried at Charlottenberg, princes and peasants alike mourning his loss.

Von Helmholtz occupied so large a part of the scientific horizon and for so long a time that we have not yet become accustomed to his absence. But it is not too soon to agree that the following admirable lines which appeared in the *London Punch* a little more than a year ago express in some measure our judgment of the man and his work:

"What matter titles? *Helmholtz* is a name
That challenges alone the award of fame!
When Emperors, Kings, Pretenders, shadows all,
Leave not a dust-trace on our whirling ball,
Thy work, oh grave-eyed searcher, shall endure,
Unmarred by faction, from low passion pure."

T. C. MENDENHALL.

CURRENT NOTES ON PHYSIOGRAPHY.

THE TEMPERATURE OF LAKES.

A CAREFUL study of the temperature of lakes, leading to important economic results in connection with water supply, has lately been completed by Desmond Fitzgerald, of the Boston Water Works (Trans. Amer. Soc. Civil Engineers, xxxiv, 1895, 67–109). Many of the observations have been taken with the thermophone (see Amer. Meteorol. Journ., xii, 1895, 35–50), thus gaining much accuracy and saving much time. It appears from the numerous diagrams and tables in the essay, as well as from the text, that small water bodies, such as Lake Cochituate, one of the chief supplies for Boston, are generally in stable equilibrium. During the winter, when small lakes are frozen, the surface water to a depth of about ten feet is colder and lighter than the great body of deeper water whose temperature is that of maximum density. All through the summer, stability and stagnation again prevail, the surface water to a depth of thirty or forty feet being then warmer and lighter than the bottom water, which remains between 40° and 45°. During this summer period of stagnation, and after the oxygen dissolved in the water has been used in the decomposition of sinking organic substances, they accumulate for the remainder of the season; the water then becomes darker and darker, until by October it is very yellow and generally of a disagreeable smell. But in April, and again in November, the temperature of the lake is essentially constant from top to bottom; the water body is then in indifferent equilibrium and is easily overturned by the wind. In November particularly this overturning brings all the impure bottom water to the surface; infusoria and diatoms begin to grow in enormous numbers, because of the supply of food thus provided. While the degree of impurity of the stagnant bottom water varies in different lakes, it may in some become a serious annoyance; and it is suggested that, where possible, the bottom water should there be drawn off from reservoirs and 'wasted' before the November overturning arrives.

WINDS INJURIOUS TO VEGETATION AND CROPS.

UNDER the above title, the late Prof. Geo. E. Curtis contributed to the International

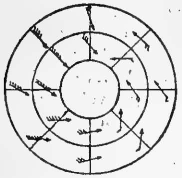
Meteorological Congress at Chicago in 1893 an essay lately published, with much other material in the second part of the report of the Congress, and issued as Bulletin II. of the United States Weather Bureau. Injurious winds are classified as violent, cold and desiccating. The first class includes the hurricane, the tornado and the thunder-squall (*derecho* of Hinrichs). The second class includes nocturnal winds, descending mountain valleys; these being quoted as injurious to the vine and limiting its area of cultivation in certain parts of Europe, but not yet known to be harmful in this country. Cold waves, blizzards and northers also belong in the second class. The deforestation of Michigan is said to have given more ready access to cold waves, hence 'the peach crop has nearly disappeared' from that State. The desiccating winds are more fully described, especially the hot southwest winds of the Plains, to which Curtis had previously given special attention (7th Bienn. Rept. Kansas State Board of Agriculture, 1891, 162–183; see also essay by Cline, Amer. Meteorol. Journ., xi, 1894, 175–186). The statistics of ten counties in Kansas in 1888 showed a loss of 21,000,000 bushels of corn alone, due principally to hot winds. These winds are chiefly of daytime occurrence, their temperature reaching over 100°, even to 109°, while their relative humidity is probably not over 20 or 25%. When the ground has been thoroughly dried, then one or two days of hot winds wither and shrivel up the crops beyond possibility of more than partial recovery. Destructive hot north winds occur in the valley of California. Timber belts are recommended as the best protection against both cold waves and hot winds.

DROUGHTS AND FAMINES IN INDIA.

John Eliot, of the Indian meteorological office, contributed a paper of much value to the Chicago Congress under the title given above. After a general account of the climate of India, in particular of the winds and rainfall, the author shows that the famine districts are all in areas of moderate or light rainfall, between 20 and 35 inches. One such area enters the southeastern coast of the peninsula and extends northwestward over the Deccan; another forms a V-shaped belt, pointing eastward and enclosing the arid desert area of the lower Indus. A late beginning of the rainy season, a prolonged break in its continuance, scanty rainfall during the period, or an early cessation of the rains, result in famine. In northern India famine is usually due either to the failure of two half-year crops in succession, to the complete failure of one crop after a succession of poor or bad seasons. In the Deccan famine follows a failure of the summer rains, after one or more bad seasons. A list of twenty-four famine years is given, beginning with 1769. Of these eight were 'intense famines,' while six were only 'severe scarcities.' The Orissa famine of 1865–66 caused a loss of life estimated at one million, out of three million population, and a loss to the State of £1,500,000. The Behar famine of 1873–4 caused an expenditure of £6,000,000, in providing relief to the distressed people; consequently the loss of life was small.

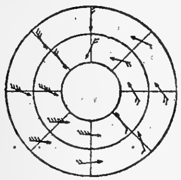
METEOROLOGICAL ELEMENTS IN CYCLONES AND ANTICYCLONES.

A valuable study of the distribution of meteorological elements around areas of low and high pressure at Vienna and at Thorshavn, Sweden, has been made by Åkerblom (Svenska Vet.-Akad. Handl., xx., 1895, Bihang, No. 3). The diagrams for surface winds and for cirrus clouds are here reproduced. It is noticeable that while the cirrus clouds over a cyclonic area show but a moderate deflection to either side of their mean course from W. 6° S., those over an anticyclonic area are deflected



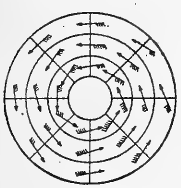
Min. Max.

Direction and Velocity of the Wind at Vienna. (Winter.)



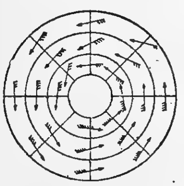
Min. Max.

Direction and Velocity of the Wind at Vienna. (Summer.)



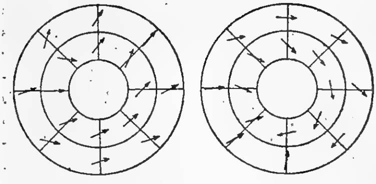
Min. Max.

Direction and Velocity of the Wind at Thorshavn. (Winter.)



Min. Max.

Direction and Velocity of the Wind at Thorshavn. (Summer.)



Min. Max.

Motions of Cirrus Clouds in Central Germany.

into a rather well marked right-handed whirl. It may be added that as far as the movement of the cirrus is concerned, it would suggest that inward baric gradients prevail aloft over cyclones and that outward gradients prevail over anticyclones, and that this is on the whole more favorable to the driven than to the convectional theory of atmospheric whirls in temperate latitudes.

W. M. DAVIS.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

IN our issue of January 10th we called attention to Dr. See's announcement of a possible perturbation of the motion of the visible components of the binary star 70 Ophiuchi by an unseen companion. The *Astronomical Journal* of January 9th contains another article by Dr. See, in which he presents his views more at length and with much painstaking care. Yet after reading his elaborate paper, we cannot see that he has established anything more than a probability in favor of the existence of the supposed body. His strongest argument is, of course, the error of five degrees found by the American observers in Prof. Schur's ephemeris. But at the time of making his calculations Dr. See was unaware that nearly contemporaneous European observations were at variance with the American ones. If we take the mean of all the observations that have come to our knowledge we get a result in very fair accord with the ephemeris. Dr. See also bases a strong argument on the measures of distance, which were not used by Prof. Schur for the well-known reason that all such distance measures are often affected with systematic errors. It is always a matter of personal opinion whether measures of distance should be used in computing the orbit of a binary like 70 Ophiuchi. In any case, the curve which Dr. See draws to illustrate the 'Perturbations in Distance' cannot be regarded as quite free from bias. Thus, if we divide the observations into three equal periods, we find:

Period.	Number of Points.	
	Above See's Curve.	Below See's Curve.
1830 to 1850,	15	5
1850 to 1870,	13	7
1870 to 1890,	2	18

It is evident that the curve needs raising at one end and lowering at the other; and if this is done, it will come near admitting of a satisfactory representation by means of a straight line. However this may be, we wish to repeat our former statement that this star is certainly worthy of close attention from double-star observers. Dr. See's research serves to emphasize this fact very strongly.

IN the *Astronomical Journal* of January 23 Dr. S. C. Chandler publishes a paper on 'Standard systems of declination and proper motion,' in which he comes to the conclusion that "the system of the *Fundamental-Catalog*, admirable as it was for its original purpose, has now broken down, and the extension of its employment up to the present time, and certainly for the future, should cease." Dr. Chandler thinks that the proper system to use is that of Boss. To prove this he compares the declinations deduced by himself in a former paper from mural circle observations at Greenwich between the years 1825 and 1848 with the corresponding declinations from Boss' catalogue and from Auwers' *Fundamental-Catalog*. The agreement with Boss is much better than that with Auwers, especially after Boss has been corrected with a small term for latitude variation. We are unable to see in these facts a sufficient justification for Dr. Chandler's strong condemnation of Auwers' system. The essential requisite of a system of star places and proper motions is not that it shall differ from the truth at all epochs by the minimum amount. It is of no great consequence if the difference from the truth be somewhat large for some epochs, but it is essential that such difference shall always admit of being expressed as a function of the declination without discontinuity. We believe that the quantity of such discontinuity involved in the use of Auwers' system is less on the average than in the use of Boss'. Whether this be so or not is at present a matter of individual opinion, depending more or less upon the weight attached to Bradley's observations. But there is another practical essential of a star system which is not at all satisfied by Boss' system. We refer to the need of keeping the system up to date. This has been done very carefully by Auwers, but for Boss' system few of the later catalogues have been treated. Thus it is practically impossible for an astronomer who wants to deduce the best possible place of a star to employ the recent accurate catalogues, if he wishes the place referred to Boss' system. H. J.

CHEMISTRY.

LOBRY DE BRUYN has succeeded in preparing hydrazine or diamide, N_2H_4, in pure condition by treating the hydrochloric acid salt with sodium ethylate and distilling. The compound crystallizes at low temperatures, and can be boiled under the atmospheric pressure without decomposition. Attempts were made to prepare diimide, N_2H_2, by treating hydrazine with iodine, but these were without success.

RECENT experiments by Gréhaut show that the effect of acetyline upon the animal system is very slight. If it unites with the hæmoglobin of the blood at all, the compound is very unstable, and not to be compared with the compound of hæmoglobin with carbonic oxide. This fact is of special interest in view of the probable extensive introduction of acetyline for illuminating purposes.

GENERAL.

AT the meeting of the Paris Academy of Sciences on January 6th M. Marey was succeeded in the presidency by M. A. Cornu, and M. Chatin, the botanist, was elected Vice-President in the place of M. Cornu. At the meeting on January 13th M. Marcel Bertran was elected a member of the section of mineralogy, succeeding Pasteur.

THE Geological Society of London will this year award the following medals and funds: The Wollaston Medal to Professor E. Suess, the the Murchison Medal to Mr. T. Mellard Reade, the Lyell Medal to Mr. A. Smith Woodward, the proceeds of the Wollaston Fund and part of the Barlow-Jameson Fund to Mr. Alfred Harker, the proceeds of the Murchison Fund to Mr. Philip Lake, the proceeds of the Lyell Fund to Dr. W. F. Hume and Mr. W. C. Andrews, and the proceeds of the Barlow-Jameson Fund to Mr. Joseph Wright and Mr. John Storrie.

IT is reported in the daily papers that Prof. A. W. Wright and Prof. John Trowbridge have repeated Prof. Röntgen's experiments with the X-rays. A cablegram states that Prof. Mosetig, of the University of Vienna, has actually used the photography for diagnosis. The photographic pictures taken showed, with the greatest clearness and precision, the injuries caused by a revolver shot inthe left hand of a man and the position of the small projectile. In the other case, that of a girl, the position and nature of a malformation in the left foot were ascertained.

THE Bill for Adoption of the Metric System, introduced in the House of Representatives by Mr. Hurley (*not Harley*), to which reference was made in the last number of SCIENCE (January 31), has been considered by the Committee of Coinage Weights and Measures, and certain amendments have been suggested, to define more distinctly what is meant by the metric system, and to extend the time for the beginning of its general use to the first day of the next century.

MRS. ESTHER HERMANN has contributed $10,000 to the endowment of the New York Botanical Garden, making the total amount $260,000 in addition to plants of the value of $5,000 given by Mr. J. A. Pitcher.

THE Russian government is expected to introduce the Gregorian calendar in 1900. This may be done suddenly or by omitting the 29th of February in the first twelve leap years.

JOSEPH FIORELLI, an Italian antequarian and archæologist, died at Naples, on January 29th, at the age of 73.

THE catalogue of members of the American Institute of Electrical Engineers shows that on January 1st there were just 1,000 members, including two honorary members, Lord Kelvin and Mr. W. H. Preece.

THE *Journal of the Royal Statistical Society* has published the report of the committee of the Berne International Statistical Institute recommending that a universal census be taken at the beginning of 1900. The dates of the census in different countries do not now coincide, but it would be a great advantage to secure uniformity of date and also of methods, and the committee hopes to accomplish this.

MR. J. Y. BUCHANAN contributes to *Nature* for January 9th an interesting account of the capture of a sperm whale off the Azores witnessed by the Prince of Monaco. The animal, when dying, ejected the bodies of huge cuttle-fish which were secured, together with others subsequently found in the stomach. Owing to the absence of the heads it was impossible to positively identify them, but they probably represent a new species of *Histioteuthis* and of *Cucioteuthis*, and an entirely new genus and species to which the name of *Lepidoteuthis Grimaldii* is given by Prof Joubain. The largest cuttle-fish body was about two meters in length. Circular marks, believed to be the impression of suckers, were found on the head and body of the whale. This account corroborates the stories long told by whalemen who have always insisted that the sperm whale in his death agonies vomited up fragments of squids 'as big around as a barrel.'

AT a special meeting of the Chemical Society of London held recently, a memorial lecture on the 'Life and Work of the late Prof. von Helmholtz' was delivered by Prof. G. F. Fitzgerald, Trinity College, Dublin. It is perhaps not known to every one that Helmholtz was a great chemist as well as a great physicist, mathematician, physiologist and psychologist. He was a foreign member of the London Chemical Society, and in 1881 filled the office of Faraday Lecturer, when he communicated to the Society his famous memoir on the 'Connection between Electricity and Chemical Action.''

THE *Zoologischen Adressbuch*, already noted in this journal, gives 2,458 addresses of zoölogists in the United States, 1,703 in Germany, 1,523 in France, and 1,469 in Great Britain and Ireland. This is a satisfactory indication of the interest taken in zoölogy in America, even though it may have happened that a larger percentage of collectors and amateurs are included in the case of the United States than in the cases of the other countries.

Mr. C. E. Borchgrevink arrived in New York on February 2d, and will lecture in America.

Alfred L. Kennedy, metallurgist and geologist, was burned to death through a fire in his room on January 30th. He was about 80 years of age.

The Montreal Branch of the British Medical Association have invited the Association to meet in Montreal this year. This invitation cannot be accepted as arrangements have already been made to meet in Carlisle, but it is probable that the Medical Association will before long follow the example of the British Association for the Advancement of Science and hold a meeting in Canada.

Acetylene gas seems hitherto to have been promoted chiefly with a view to selling stocks and franchises, though we understand the process is not covered by patents. It seems, however, probable that the gas will have important practical applications, which shows once more the practical importance often following chemical research. Acetylene gas is a hydrocarbon compound resulting when water is added to calcic carbon, which is made by fusing lime and carbon in an electric furnace. The only commercial acetylene is now made at Spray, N. C., but it is reported that a furnace is being erected at Niagara Falls, and that large quantities of the gas will soon be manufactured. The advantages of the gas are its brilliant white light, ten to twenty times as great as coal gas, its portability and (it is claimed) its cheapness. It should be remembered, however, that it is poisonous, and, especially in certain compounds, explosive.

An editorial article in the February number of *Appleton's Popular Science Monthly* on 'The Hundredth Anniversary of the French Institute' states that "As yet, the name of no citizen of the United States has been inscribed on the roll of the foreign associates of the Institute, although it is understood that in a recent election to fill the vacancy occasioned by the death of a member the name of Prof. Simon Newcomb, of Washington, lacked but a few votes of receiving this honor." Prof. Newcomb was elected an associate member on the 17th of June of last year, succeeding von Helmholtz, as announced at the time in this journal. The name of Prof. H. A. Rowland should be added to the list of American correspondents given in *Appleton's Popular Science Monthly*. The six American correspondents are: Asaph Hall, B. A. Gould, S. P. Langley, H. A. Rowland, James Hall and A. Agassiz.

John Wiley & Sons announce for July next a volume on *Higher Mathematics for Engineering Colleges*, edited by Prof. Mansfield Merriman and Prof. R. S. Woodward. The work is intended primarily for the use of Junior and Senior Classes in schools of engineering, and contains a concise treatment of subjects not commonly found in text-books, but upon which lectures are now given in the best classical and technical institutions. In addition to chapters by the editors on the Solution of Equations, and Probabilities and Theory of Errors, the work will contain the following chapters: Prof. W. E. Byerly, of Harvard University, Harmonic Functions; Prof. T. S. Fiske, of Columbia College, General Theory of Functions; Prof. G. B. Halsted, of University of Texas, Projective Geometry; Prof. E. W. Hyde, of University of Cincinnati, Point Analysis and Ausdehnungslehre; Prof. W. W. Johnson, of U. S. Naval Academy, Differential Equations; Prof. A. Macfarlane, of Lehigh University, Vector Analysis and Quaternions; Prof. J. McMahon, of Cornell University, Hyperbolic Trigonometry; Prof. F. Morley, of Haverford College, Elliptic Integrals and Functions; Prof. D. E. Smith, of Michigan Normal School, History of Modern Mathematics; Prof. L. G. Weld, of University of Iowa, Determinants.

Macmillan & Co. announce a work on 'Social Interpretations of the Principles of Mental Development,' by Prof. J. Mark Baldwin, of

Princeton, and 'An Outline of Psychology,' by Prof. E. B. Titchener, of Cornell University.

DR. DONALDSON SMITH gave before the Royal Institution, London, on January 20th, an account of his expedition to Lake Rudolf, in northeastern Africa. It was found that the Nianann is the only river emptying into the lake, and that there is no river Bass, as supposed by Count Teleki. Seven hundred birds were collected, and of these 24 have been described by Dr. Bowdler Sharpe as being new to science. The different species of insects numbered 3,000, and besides these there were many plants, butterflies and mammals collected.

A HEARING was given on January 30th by the Commissioners of the District of Columbia upon a Senate bill which would prevent vivisection in the District. Dr. Busey and Surgeon General Sternberg spoke against the bill.

MEMBERS of the Gypsy Moth Commission of the Massachusetts State Board of Agriculture appeared before the Committee of Agriculture and argued in favor of the passage of an appropriation of $200,000 for the work of exterminating the gypsy moth. It was stated by director E. H. Forbush that 425 men would be needed during the spring and summer; it is proposed to burn over infested waste lands which is done by means of a machine which throws out a spray of oil which burns so rapidly that the eggs and caterpillars are destroyed without injury to the trees, then the trees are burlapped and examined, and eggs laid during the season are so far as possible destroyed. Roads would be examined with special care to prevent caterpillars from dropping on passing teams and being thus carried to uninfested localities.

UNIVERSITY AND EDUCATIONAL NEWS.

AT a meeting of the convocation of the University of London on January 21st a resolution was passed, 460 votes being in its favor and 240 against it, favoring what is known as the Cowper Commission Scheme for the consolidation and reconstruction, of the examining and teaching institutions of London. It should be remembered that the University of London does not give instruction, but only grants degrees on examination, whereas there are also in London two or more colleges which give instruction but do not grant degrees. It is universally admitted that some reform is needed, either that the teaching institutions should be consolidated and permitted to confer degrees on their students, while the University of London remains purely an examining body, or that all the institutions should be united. As appears from the above vote, the members of the convocation of the University of London attending the meeting favored the latter plan, but it is claimed that it would not have the approval of a majority of all the graduates.

A PUBLIC meeting has been held in Albany urging the removal of Union University from Schenectady to that city, and it is understood that the matter will be seriously considered by the trustees.

MR. JOSEPH BANNIGAN has given $4,000 to the Catholic University of America, and has made known his intention to donate for twelve years $4,000 a year for library purposes.

BY the will of the late Mrs. Doyon, the University of Wisconsin has received $5,000, the income of which is to be devoted to scholarships for young women.

Two scholarships of $2,000 each have been presented to Tufts College, one by Mrs. A. B. Perkins and the other by J. S. and H. N. White.

DR. L. TRENCHARD MORE, of St. Louis, Mo., has become an assistant in physics at the Worcester Polytechnic Institute.

DISCUSSION AND CORRESPONDENCE.

THE INVERTED IMAGE ON THE RETINA.

EDITOR OF SCIENCE: Prof. Brooks can hardly hope that there should be any consensus among scientific men in regard to the difficult question whether we know or do not know whether the lower animals have or have not consciousness, if there are still distinguished scientists who think that there is anything which needs explanation in the fact that the image on the retina is inverted, or that the question will continue to be a subject for discussion for centuries yet to come. As long as we do not *feel* that the image on the retina is inverted, as long as we are not aware in consciousness that there is an image or a retina, however much we may have formed the one and dissected the other, it makes no difference whether the image is inverted or not. With a proper distribution of nerve ends we could get on perfectly well with a three-dimensional image formed in the vitreous humor in the interior of the globe of the eye—what was once supposed to be the scheme of vision, a scheme which would have had the immense advantage of saving us a lot of thinking in the effort to understand how we see out- and in-ness. We could also get on perfectly well if the flat image which is actually produced were broken up into a thousand parts, and the parts distributed upon the retina in any confused order whatever, provided the order were a perfectly fixed one, and provided also (possibly) that the eyes were immovable in the socket.

While we are not conscious of the image nor the retina, we are conscious of the movement of the eye in the socket. With the present arrangement, when we reach the hand upward to touch an object, we also move the eye upward to fixate it, that is, the front half of the ball of the eye, which is the part we are familiar with on account of seeing its motion in other individuals and in our own mirror. If the image were not inverted and we had to move the eye to the left at the same moment that we move the hand to the right, there would then be something to be explained, though this incongruity would doubtless be perfectly overcome by experience.*

I touched my little girl of eleven with a pencil point on one corner of her eye and asked her what she saw. "I see a round whitish spot over there," she said. "Is it not strange," said I, "that when I touch you on the right, you see something on the left?" "No," she said, "I do not think it is strange at all." What, said I to myself, Prof. Le Conte is then right, and all the psychologists are wrong—this child is aware that rays of light cross within her crystalline lens, and that when she sees an object on the left it is because her retina has suffered an affection on the right, in spite of the fact that she has never heard of retina or of crystalline lens? But on questioning her farther I found that this was not the case. She had formed a rapid hypothesis to account for the otherwise unintelligible fact, namely, that the pressure of the pencil was communicated straight across the eyeball and affected it on the opposite side. It had not entered into her mind to conceive that a sensation on the right was not due to something going on in the right hand half of her eye, and she had no intuitive idea of projection through a point.

The psychologist's view is thus summed up by Professor James (*Principles of Psychology*, II., 42): "I conclude then that there is no truth in the 'eccentric projection' theory. It is due to the confused assumption that the bodily processes which cause a sensation must also be its seat. It is from this confused assumption that the time-honored riddle comes of how, with an upside-down picture on the retina, we can see things right side up. Our consciousness is *naïvely* supposed to inhabit the picture and to feel the picture's position as related to other objects of space. But the truth is that the picture is non-existent, either as a habitat or as anything else, for immediate consciousness. Our notion of it is an enormously late conception. * * * Berkeley long ago made this matter perfectly clear (see his Essay towards a New Theory of Vision, §§ 93–98, 113–118)."

Külpe, in his *Outlines of Psychology*, has attached himself to the position of James and Stumpf (and James mentions Professor Le Conte as one of the two or three writers who have given him most aid and comfort in supporting his position) to the effect that retinal impressions are from the first endowed with a spatial quality, in opposition to Helmholtz and others, who regard visual space sensation as purely a system of signs for effecting a one-to-one correspondence with tactual space sensation. To Professor James' argument, which is already inexpugnable, Külpe adds the testimony of a

*If the eyeball be moved up and down by the finger, objects looked at seem to move also. Prof. James has suggested that some one try the experiment of moving the eye in this way for many hours at a time, and he predicts that here also experience would have her perfect work, and that in time this apparent motion of objects would no longer take place.

fact of pathology, which by itself would be enough to settle the question—the rare cases, namely, of metamorphopsia. It sometimes happens that a piece of the retina is detached by means of a wound, and that it afterwards grows on again in a wrong position, and vision is regained, but things are out of place. A case has just been reported before the Italian Ophthalmological Society, in which distorted vision occurred over the portion of the retina affected, the inversion being from right to left, but not also up and down (showing, therefore, in addition, that the retina can still perform its function when it is wrong side out). Such cases as this are also plainly incompatible with a projection theory. C. L. F.

BALTIMORE, MD.

MARSH GAS UNDER ICE.

PROF. REMSEN'S note under the above title in SCIENCE for January 24th, p. 133, is of more than local interest. So far as I am aware, the phenomenon of gas spurts through ice has not before been described. As early as the winter of 1878–'79 the writer observed, at West Summit, N. J., the ice on a bog covered with miniature craters and mounds of new ice. These ice accumulations took place about vents up through which came water and gas bubbles, the former charged with the brick-red ferruginous deposit at the bottom of the bog. Frequently the vent was along the side of a blade of bog grass. During the winter, the surface of the ice on the bog become very rough by the additions made in this way. The flocculated bog ore thus brought to the surface was, during times of rain and thaw, washed into the neighboring stream, so that the process tends to retard the growth of bog ore deposit. Similar outbursts may be observed during the winter where a coating of ice forms over a lawn which has been treated with ordinary manure in the autumn. Gas spurts break out after a period of continued cold, and the surface of the ice becomes discolored with the products urged up by the escaping gas. An instance of this action was to be seen on the grounds of the Museum of Comparative Zoölogy at Cambridge last winter. It would be of some importance in glaciology to ascertain what part this escape of gas plays in the breaking-up of the ice on shallow ponds and lakes. J. B. WOODWORTH.

CAMBRIDGE, MASS., January 27, 1896.

ETHNO-BOTANIC GARDENS.

THE purposes of a museum are twofold: First, it is to be a place of instruction where the general public can resort for information as to objects from distant or foreign lands; second, it is to be a place for scientific research. A museum fulfills its purpose best when both of these objects are kept in view. The collections should be so arranged as to teach the public by object lessons, and at the same time be adapted for scientific work. Most of our colleges have kept these objects prominent in the fore front, and many of them have arranged synoptical collections for the instruction and edification of visitors. Several of the larger institutions of learning, notably Harvard and the University of Pennsylvania, have buildings set aside for museum purposes, and it is, therefore, to them that we must turn when we desire to study the operation of museums with educational views and aims.

The University of Pennsylvania proposes to erect, in the near future, a series of museum buildings, which will bring the institution into closer touch with the general public, and at the same time give the students in the several departments a chance for original research work. It is intended by the University authorities to place the buildings in a public park to afford better light for exhibition purposes, and so as to display to better advantage the architecture of the structures. A separate building it is planned will be devoted to archæology and ethnology. Such a building is badly needed at present, for the anthropological collections in general have accumulated to such an extent as to crowd the space in the library now allotted to them.

The opportunity is presented when these buildings are erected to construct an ethnobotanic garden in connection with the public park. It is to the outlining of the purposes of such ethno-botanic gardens, in general, that this article is directed.

1. Only aboriginal American plants should find a place in such a garden. No plant can be found more graceful than maize, a grass asso-

ciated with the myths of the aboriginal races of America, and worthy to be our National emblem. This plant has been little thought of for decorative purposes in our gardens; yet, it is decidedly ornamental and worthy of esteem. The sunflower, too, ought to be grown. The Indian recognized its value, for the Moquis and Ava-Supais planted it for food, and used the ground seed mixed with corn meal as a dainty. Several travelers have described the plant as grown by the inhabitants of the far Southwest. Tobacco should not be forgotten. The European owes much to this weed, nor is he the only one who enjoys it, for the Redman from the earliest time smoked the pipe of peace and, as the wind wafted the smoke upward, offered significantly a prayer to the Great Spirit. The tomato with its crimson fruit, the pumpkin vine, the bean and the potato should find their place as vegetables of aboriginal use in some corner of the garden. The oak, yielding acorns; the willow, dye stuffs, can be placed to good advantage near the pond in which grow Wah-es-i-ping, *Sagittaria variabilis Engelm*; yellow lotus, *Nelumbium luteum* L.—both furnishing aboriginal root esculents; water cress, *Nasturtium*, a salad plant, and wild rice, *Zizania aquatica*, L.

A partial list will show the large number of 'Indian' plants which a gardener could use:

Nymphæa odorata, L.	*Physalis grandiflora.*
Nuphar advena, Ait.	*Diospyros virginiana, L.*
Prunus virginiana.	*Plantago major, L.*
Fragaria sp.	*Betula papyrifera, Marsh.*
Amelanchier Canadensis, Torr. & Gr.	*Thuja occidentalis, L.*
Ribes hirtellum, Mx.	*Pinus monophylla, Torr. & Frem.*
Larrea Mexicana, Moric.	*Juglans nigra, L.*
Apios tuberosa, Ph.	*Acorus calamus, L.*
Celastrus scandens, L.	*Typha latifolia, L.*
Cornus Canadensis, L.	*Scirpus lacustris, L.*
Chiogenes hispidula, Torr. & Gr.	*Lilium superbum, L.*
	Oryzopsis membranacea.
Vaccinium.	*Phragmites communis, Trin.*
Ledum palustre, Ait.	
Aralia nudicaulis, L.	*Zea mays, L.*

2. The plants should be arranged with reference to the Indian tribes which used them. The plants of the Algonquins should stand apart from those of the Iroquois; those of the Aztecs from those of the Pueblos. Such a geographical arrangement is most desirable for educational purposes.

3. An arrangement according to the uses of the plants ought also be made. The strictly agricultural plants, such as corn, beans, potatoes and pumpkins, ought to be sown in one bed, the fibre plants, like basswood, *Tilia Americana, L.;* spruce, *Picea;* sumach, *Rhus aromatica;* willow, *Salix lasiandra, Benth;* unicorn plant, *Martynia proboscidea, Glox;* tree yucca, *Yucca brevifolia, Engelm;* ash, *Fraxinus*, in another; the dye plants, as alder, *Alnus incana, Willd;* celandine, *Chelidonium majus, L.;* smart weed, *Polygonum Hydropiper;* poke, *Phytolacca decandra, L.*, *Coptis trifolia, Salisb.*, in another.

The myth plants and medicine plants also are important as showing the culture of the aborigines. They by no means should be excluded from the garden.

The educational purposes of such an ethnobotanic garden have so far been discussed. The question may arise: What is the scientific value of such a garden? It is this: Frequently in studying the articles manufactured from plants by the Indians, it is difficult to determine what plant was used in each particular case. A histologic study of the vegetal tissues will give sometimes a clue, and if the microscopic structure of the manufactured article be compared with the fresh plant an identification is in many cases possible. To cite a case, the writer was asked not long since to identify the plant forms found on certain Central American tablets.* He was almost certain that the leaf found at the base of the cross, in the celebrated Tablet of the Cross, was that of the tobacco. The Herbarium specimens of the genus *Nicotiana* were examined, but showed very imperfectly the auricles at the base of the leaf which were so plainly marked in the conventionalized sculptured form. Had he had the plant growing somewhere, the identification could easily have been made, certain garden forms of tobacco, which he afterwards saw, showing the auriculate base clearly.

*See a paper of mine on the subject, Plant Forms on Mexican and Central American Tablets. American Antiquarian, XVI., 299, September, 1894, in connection with the ¶ on the Tablet of the Cross.

There can be no doubt, therefore, that such an ethno-botanic garden would stimulate greatly the interest in aboriginal plants, and at the same time it would be of the greatest scientific value. Nothing of the kind has ever been attempted along the lines suggested above, and such a garden would soon become a Mecca for those who desire to write monographs upon our American plants and their uses among the aborigines.

J. W. HARSHBERGER.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC LITERATURE.

Certain Sand Mounds of Florida: By CLARENCE B. MOORE.

I have elsewhere* called attention to the important work which Mr. Moore is doing toward the elucidation of the archæology of Florida, a research to which he has given his personal attention for several years. The third memoir† on this subject contains the results of his field work from January 16th to June 16th, 1895.

Mr. Moore has now examined with great care nearly all the earthworks of the St. Johns and Ocklawaha valleys. Of this large number only two were erected after white contact. That is, in only two were found objects obtained from the whites and placed with the original interments in the mounds. In several instances glass beads and other manufactures of the whites were found on or near the surface of a mound, or with intrusive burials of recent times; and Mr. Moore shows how easily such recent things might be taken as evidence of recent origin of the mound in which they are found. It is only by such thorough work as Mr. Moore is doing that our American archæology is advanced, and it is therefore with a feeling of satisfaction that we read the account of his careful field work and follow the true archæologist from page to page as he patiently describes each mound and its contents, and notes the position of every skeleton and object described.

The author of these memoirs takes the field fully equipped for the thorough prosecution of this work, and employs from twenty to forty laborers under experienced guidance. He also prints and illustrates his papers in a handsome manner. The objects are well illustrated, nearly always of natural size, and, what is greatly to be commended, the artistic desire of the draughtsman to make them look a little better than the originals is not apparent here. The explorer in several instances states that he did not take to his collection in Philadelphia such and such potsherds or other fragmentary objects because he had many perfect specimens of the same type. This is to be regretted since every archæologist is not so fortunate as he, and the very potsherds which he discards would be treasured in many a museum, particularly as Mr. Moore's work in the field is so thorough that nothing is left for another in the same region. Even this regret is tempered when we know how liberal Mr. Moore has been in supplying several museums with representative collections from these Florida mounds.

It is yet too soon to draw conclusions as to the peopling of Florida or as to the time when these burial mounds were first formed. Wyman showed by his research that many of the shell mounds of the St. Johns were of great antiquity, and that there were certainly two and probably three phases in the life of the people who formed them. From Mr. Moore's explorations, it seems likely that the sand mounds—as old as many of them unquestionably are—belong to the later period of the shell mounds, and in a few instances come down to the time of European contact.

One of the questions not yet fully answered is that of the relation of the early people of Florida with other tribes. We know that among the most recent were the mixed people known as the Seminoles. We also know that Florida was inhabited in very early times, as shown by the discoveries of Pourtalés and later by Heilprin. We can now trace by the artifacts brought to light in the burial

* The Harvard Graduate Magazine of June, 1895.

† Certain Sand Mounds of Duval County, Florida; two mounds on Murphy Island, Florida; and certain Sand Mounds of the Ocklawaha River, Florida. By Clarence B. Moore. Journal of the Academy of Natural Sciences of Philadelphia, Vol. X., 1895, 4to, 108 pages. 91 illustrations in the text; two maps; 16 plates of pottery and a frontispiece illustrating a large conical mound.

mounds that there must have been a widely extended trade with tribes of the interior, and possibly a migration from the central portion of the continent to Florida. The large number of copper objects found by Mr. Moore, many of the same character and in some cases identical with those found in the Ohio mounds, is evidence of contact. The copper itself, which probably came from the Lake Superior region, is an important factor in this connection. The skulls found in the Florida mounds are of the brachycephalic type, closely resembling those from other southern mounds. The pottery, however, is different to a marked degree. The stone 'celts' or hatchets are distinctly of the extreme southern type, bordering on the West Indian. Is there Carib infusion from the islands or from the northern coast of South America? There are indications in this direction.

The oldest perfect skull known from Florida is extremely dolichocephalic and entirely different from the mound type. This was found by Wyman at the bottom of the great shell heap near Hawkingsville on the St. Johns. This heap was so old that its lower layers of the shells had become decomposed and transformed into a limestone in which this skull and other bones of the skeleton are firmly imbedded. We naturally question if this skeleton is not that of a survivor of the earlier people who were on the peninsula before the short-heads came.

Thus there is a complicated problem which can be solved only by such careful field work as was begun by the late Jeffries Wyman and is now being continued by Mr. Moore. In this connection it is interesting to know that Mr. Frank H. Cushing is now engaged in explorations on the west coast of Florida, under the auspices of the archæological department of the University of Pennsylvania.

Mr. Moore in this last memoir has described and figured a number of vessels and singular objects of pottery, which he designates as 'mortuary' and 'freak' pottery. This pottery, to which I called attention in my notice of his first and second memoirs, is, thus far, peculiar to these Florida mounds. The forms he designates as freaks' are very odd and are apparently, useless for any practical purpose. Perhaps *ceremonial* would be a better designation, since we know that among other peoples pottery of a certain character was made for ceremonial purposes, and that such vessels were often placed with the dead. That mortuary vessels were sometimes made for this special purpose is indicated by the fact that holes were purposely made in many of the vessels before they were subjected to burning or baking; while vessels of utility were sometimes perforated or even broken into several pieces before being placed in the mound. Among some tribes the breaking of a vessel or an implement is to 'kill' it, that its spirit may accompany the spirit of the dead person; and some such idea may have prevailed here. This would be another indication of the culture of the people coming from the west, which would agree with other facts pointing to such a migration of the southern brachycephali. It is also interesting to note here the resemblance in this respect to the mortuary customs of some of the peoples in Europe in ancient times who made special vessels of pottery for burial with the dead, and even manufactured them with holes in the bottom the same as was done in Florida. Is this simply a psychical coincidence in the development of culture in places so widely separated, or is it an indication of man's migration in early times?

On page 74 Mr. Moore gives an illustration of a little piece of pointed and oxidized iron, less than an inch long, which in itself seems insignificant. This fragment would have been overlooked by a less careful observer or would perhaps have been taken for the end of a nail and so put down as proof that the mound was made after European contact. Mr. Moore himself thinks that it must be carefully considered from this point of view, while at the same time he suggests that it may be of meteoric origin. To me this bit of iron is most significant, for it closely resembles several small awls or piercers I have found in the Ohio mounds, some of which were so well preserved as to furnish the proof that they are made of meteoric iron. In 1882 I was puzzled by a mass of iron rust and fragments of iron found during the exploration of the great group of mounds known as the Turner group in Anderson county, Ohio, where

Dr. Metz and I carried on a ten years' exploration for the Peabody Museum. The finding of this iron at first seemed to prove that the builders of the mound must have been in contact with Europeans, and yet I knew that every indication of great antiquity was present. Tree growth, formation of soil over the mounds, and the formation of limonite by infiltration, were among these evidences. Still here was iron in considerable quantities, and it became an important question as to its origin. A piece was cleaned for analysis and nickel was shown to be present. Then a mass weighing 37 ounces was cut, and the section showed crystals of olivine as well as the nickel. Soon we found we had ornaments and implements made of the same material. These were all made by hammering the metal in the same way as similar ornaments and implements were made of copper. Thus we proved that this ancient people had found masses of meteoric or native iron, and had used it the same as they did native copper. Since then I have identified ornaments and fragments from certainly three distinct meteorites in our explorations of Ohio mounds in widely separated parts of the State. Among the implements are small axes, chisels and awls or piercers. Some of the latter so closely resemble this piece found by Mr. Moore, particularly in its flaky oxidation, as to strongly suggest that the object is purely of native make from a piece of meteoric iron. I may mention here that native copper, native silver, native gold and native or meteoric iron were found together on one altar in the Turner group in Ohio, and also implements and ornaments made from these metals. In this connection I will again call the attention of archæologists to the important contribution on the sources of native copper given in the second of this series of memoirs by Mr. Moore. In this he has shown that the copper objects from the mounds were made of *native* copper. He has thus confirmed the views of those archæologists who have denied the European origin of the copper.

For many other interesting points relating to the art and culture of the people who buried their dead in these Florida mounds, I must refer the reader to these instructive memoirs. I am pleased to state that Mr. Moore is at the present time continuing his researches in Florida, and we shall undoubtedly soon welcome another paper from him giving the results of this winter's work. F. W. PUTNAM.

PEABODY MUSEUM, HARVARD UNIVERSITY.

The Dispersal of Shells. An inquiry into the means of dispersal possessed by fresh-water and land Mollusca. By HARRY WALLIS KEW, F. Z. S., with a preface by ALFRED RUSSEL WALLACE, LL.D., F. R. S., etc. With illustrations. London, Kegan Paul, Trench, Trübner & Co., Ltd. 1893.

Although this little book has been published for some time, the subject is one of perennial interest, as naturalists will continue to gather facts bearing upon it. Though at first sight a rather limited field of inquiry, the author treats of it in a fairly comprehensive way, the chapters discussing the anomalies in local distribution, means of dispersal of fresh-water and of land shells, transplantation of bivalves and of univalves, the tenacity of life of land shells, the dispersal of slugs, the dispersal of fresh-water and land mollusca by man, the ninth and last chapter dealing with the fresh-water and land mollusca introduced into the British Isles by human agency.

The book will be of value to American conchologists and field naturalists, as it is by no means of local interest.

Of a curious nature are the facts collected by the author relating to the transportation of fresh water bivalves by insects, batrachians and birds, with the figures in illustration.

We see nothing special to criticise, nor are we aware of any omissions, except two which it would have been well for the author to have mentioned. The first is the introduction, by probably human agency, of *Helix hortensis* at different points on our northern coast, although it is not clearly proven that the species is not indigenous, yet this does not seem to us probable. Binney concludes that it has been undoubtedly imported to this continent.

In Gould's illustrated report on the invertebrata of Massachusetts, edited by Binney, this species is said to be "An European species introduced by commerce (?) to the northeastern portion of North America. It is found on islands along the coast from Newfoundland to Cape Cod, and on the mainland plentifully, in Gaspé, C. E.; also along the St. Lawrence." It also inhabits Greenland, but Vermont and Connecticut are mentioned with doubt. It is said to be common on the lower parts of Cape Cod and Cape Ann, and is very abundant on Salt Island, near Gloucester.

It thus having been adventive on our northeastern coast for at least somewhat over sixty or more, probably seventy-five, years (since it is mentioned by Mrs. Sheppard in the Transactions of the Literary and Historical Society of Quebec, I., p. 193, 1829), it is interesting to note the fact that a new variety has apparently evolved in this country, so different from any known to exist in the old world that Dr. Binney described it in 1837 as a new species under the name *Helix subglobosa.* "The specimens first discovered by Dr. Binney were all of the plain greenish-yellow variety; and, though he could not fail to perceive their affinity to the *H. hortensis,* he thought he discovered differences enough to entitle them to a specific distinction, and therefore described them under the name of *H. subglobosa.* But numerous specimens have since been brought from the same vicinity, bearing all the various zones of the European specimens."

Perhaps a new locality, or one not generally known, is a small, quite inaccessible islet in Casco Bay called 'the Brown Cow,' between Portland and Harpswell. We found them in abundance over ten or fifteen years ago, and again in the summer of 1895. As stated by Binney, we also found their habits entirely different from those of *H. albolabris* and *alternata,* in crawling up the stems and over the leaves of tall plants, so that they have retained unaltered this habit of their European ancestors. The greenish-yellow variety *subglobosa* greatly outnumber the banded variety. Like other introduced species, they are much more prolific and numerous in individuals than the native species.

The other omission is the farther history of the case of the introduction, briefly referred to by Mr. Kew, 'a few years ago,' of *Helix nemoralis* from Europe into Lexington, Va., which is given by Prof. T. D. A. Cockerell in *Nature* for February 27, 1890, when he remarks: "Under the new conditions it varied more than I have ever known it to do elsewhere, and up to the present date 125 varieties have been discovered there. *Of these, no less than sixty-seven are new, and unknown in Europe, the native country of the species!* The variation is in the direction of division of the bands.

The facts collected in this little volume by Mr. Kew would seem, then, to be a necessary preliminary to a study of the varieties set up in immigrant species, and this will throw much light on the general question of the origin of species, the primary factors in the evolution of such forms being migration, exposure to new climatic conditions, and geographical isolation. These would seem to be sufficiently efficient and apparent causes of variation, without calling in, in such cases, the aid of natural selection.

A. S. PACKARD.

Laboratory Manual of Inorganic Preparations, by H. T. VULTÉ, Ph. D., F. C. S., Professor of Chemistry in Barnard College and assistant in Chemistry at the School of Mines, Columbia College, N. Y., and GEORGE M. S. NEUSTADT. New York, G. G. Peck. 1895.

There can be no doubt that a carefully preprepared manual of Inorganic Preparation is desirable. This book is not carefully prepared. The authors in their preface state that this book is compiled from the works of Erdmann and Fresenius and from various chemical journals. The articles translated from Erdmann are good, for Erdmann tested the methods before recommending them. Through a careless blunder in the translations of Erdmann's instructions for making iodine pentoxide from iodine and nitric acid, the student is told to use '158 c. e. of water and nitric acid.' Erdmann says 'anhydrous nitric acid.' Every chemist knows that unless the nitric acid is anhydrous, it does not yield iodine pentoxide.

On page 123 the author states that in distilling nitric acid at 121° an acid of the composition $2HNO_3+H_2O$ distills over. Of course, the acid HNO_3+2H_2O is meant. The abstracts of some of the articles from chemical journals are very carelessly written. On page 129 is an abstract entitled 'Pure Phosphoric Acid from Sodium Phosphite.' ('Phosphate,' of course, is meant, as two pages further on an abstract on Calcium Phosphide is printed 'Phosphite,' but these are mere printer's errors; the book is full of such.) In the directions no reference is made to a filtration or other mode of separation of phosphoric acid formed from the by-product. The same criticism applies to the next method, 'Phosphoric acid from calcium phosphate,' though both the original articles mention the modes of separation, and careful attention to details is necessary in a laboratory manual.

On page 174 is an abstract of an article by E. J. Maumené, entitled 'Chydrazaïne or Protoxide of Ammonia.' The attention of the present writer was attracted by the statement at the end of the abstract, that 'on evaporating Chydrazaïne nitrate, nitric acid, nitrogen peroxide, nitrogen and a compound having the composition N_2H_2 are evolved.'

Suprised at finding the long-sought-for diimide as a by-product in a preparation for college students, the original article was consulted. Maumené is responsible for diimide and chydrazäine, and this is not the place to offer any further criticism of his work than to call the attention of the authors to the fact that the existence of chydrazäine has not been confirmed. Maumené uses a solution of potassium permanganate and sulphuric acid. He says, 'je les versais doucement dans une dissolution faite à l'avance de 111 grammes ammonium oxalate róel, cést a dire $111 \times \frac{78.86}{62} = 141.2$ sel cristallisé bien sec; le mélange était fait avec soin dans mon mélangeur; nécessaire en pareil cas.' The authors abstract this in these words. "A solution of potassium per maganate (158 grams) and sulphuric acid (40 grams SO_3) is added to dried crystallized ammonium oxalate (141.2 grams), the whole well mixed." Comment is unnecessary.

If this review be deemed harsh, the writer pleads that no one should publish a laboratory manual of preparations without knowing that the preparation of all substances described is not too difficult for students, and that the directions given are good and clear. By careful revision and excision, the authors can make their manual very valuable, as it contains an abundance of excellent matter.

E. RENOUF.

A Handbook of Industrial Organic Chemistry. By SAMUEL P. SADTLER, PH. D., F. C. S. 2d Edition, revised and enlarged. Philadelphia, J. B. Lippincott Co. 1895. 8vo., pp. 537.

That a second edition of this work should be called for within four years after the first appeared is evidence that the book has met general approval and satisfies the requirements it was intended to fill. The dearth of works of this class in the English language has been felt by instructors of technical chemistry for a long time, and consequently this volume, enlarged and improved and brought up to date, will be received with pleasure by every teacher of the subject. The chemical manufacturer and general reader will also find this an excellent work, neither too brief in its treatment of the several subjects, nor too abstruse in dealing with the minor details of processes or apparatus, and happily within the reach of modest pocket books.

There is no change in the manner or order of treatment of the various industries from that adopted in the first edition, but numerous additions and corrections have been made in the text. The bibliographical lists at the close o[I] the several chapters have been entirely revised, added to and brought up to the present time. This feature of the book is one of its most valuable points, since it places at the disposal of the reader a very complete list of works on any of these industries, should he desire more detailed accounts of processes or apparatus, thus saving him hours of laborious search through library or publishers' catalogues.

The numerous tables of statistics have been corrected and increased with the latest data obtainable and add much to the value of the book. In the appendix new tables showing the chemical and physical constants of oils, fats and waxes have been added.

The schematic tables of the various processes, scattered through the book are a great assistance to the reader, by showing at a glance the connections between different parts of the processes and also aiding to refresh the memory in reviewing the work.

The subjects treated are briefly: Petroleum and Mineral Oils, Fats and Fatty Oils, Essential Oils, Resins, Cane Sugar Industry, Starch and its alteration Products, Fermentation Industries, Milk, Textile Fibres of Vegetable and Animal Origin, Animal Tissues and their Products, Destructive Distillation, Artificial Coloring Matters, Natural Dyes, Bleaching, Dyeing and Textile Printing. A very complete index adds to the convenience and worth of the book. The print is excellent, and numerous illustrations are distributed through the text. It is, as its name indicates, a 'handbook,' in which the various subjects are concisely and clearly explained, important topics being quite fully considered, while details of less importance, which often become so confusing and wearying to the student or general reader, are but slightly touched upon or entirely omitted. It is presumed that the reader who wishes minute and extended descriptions will look for them in the larger works or special literature bearing on the particular point in question.

This book presents, to a greater extent than any other work on the subject, processes and apparatus employed in America and hence will find favor with American readers. A translation which has appeared in German demonstrates, however, that it is also appreciated on the other side of the Atlantic.

It is to be hoped that a companion volume dealing with the inorganic side of technical chemistry may soon appear.

FRANK H. THORP.

SCIENTIFIC JOURNALS.

THE AUK, JANUARY.

WITH the present number '*The Auk*' enters upon its thirteenth year of publication as a quarterly journal of Ornithology, and the official organ of the American Ornithologists' Union. The first article is a memorial sketch of the late George N. Lawrence, of New York City, by D. G. Elliot. Mr. Lawrence died in January, 1895, in the ninetieth year of his age, being the last of the links connecting the present generation of ornithologists with the Audubonian period. He was the last also of the great trio of ornithologists—Cassin, Baird and Lawrence—who from the middle of the century onward laid anew the foundations of American ornithology. For a period of over fifty years Lawrence published almost continously on American birds, more especially on those of the West Indies, Central and South America, on which he was everywhere recognized as a leading authority. Mr. Elliot, from long personal acquaintance with Mr. Lawrence, was well fitted to unfold the tale of his simple life, which he has here done with rare felicity. An excellent portrait of Mr. Lawrence forms a fitting frontispiece to the number.

Mr. Frank M. Chapman, in an article on 'The Standing of *Ardetta neoxena*,' illustrated with a colored plate, gives the technical history of a rare and peculiarly interesting Heron, described about ten years since from a specimen taken in the Florida Everglades, but now known from about fifteen specimens, of which seven have been taken at Toronto, Canada, one each in Michigan and Wisconsin, and the rest in Southern Florida. D. G. Elliot describes two new Ptarmigans from the Aleutian Islands, A. W. Anthony, a new woodpecker from California, Gerrit S. Miller, Jr., a new jay from Mexico, and William Brewster, a new warbler and sparrow from North America. George H. Mackay writes of the Colony of Terns that still, thanks to careful protection, have their home on Muskeget Island, Massachusetts; L. Belding gives a rendering in musical notation of twelve songs of the meadow lark; and Miss Florence A Merriam writes at length on the habits of the Phainopepla in California. Other leading articles treat of the Pine Grosbeak, of an important factor in the study of Western bird life, and of the Thirteenth Congress of the American Ornithologists' Union, held in Washington, November 11–14, 1895. Some fifteen pages are devoted to 'General Notes,' under which are grouped some thirty short articles relating to the occurrence or habits of as many little known birds, while nearly twenty pages are devoted to reviews of current ornithological literature. There are also several pages devoted to obituaries and to various items of ornithological news.

THE AMERICAN GEOLOGIST, FEBRUARY.

Notes on the Geology of Eastern California: By H. W. FAIRBANKS. This part of the Great Basin, on account of its desert character and remoteness, has been little explored geologically; the present paper contains in part data obtained by the author during five months in 1895. The formations represented are divided into sedimentary and igneous, the former of which includes two distinct classes: (1) a metamorphic series, ranging in age from Cambrian through the Triassic, and (2) the unaltered Tertiary and Quaternary beds. The igneous rocks are granitic and volcanic; the former occur frequently as intrusions in the metamorphic series, and the latter consist of tuffs, liparites, andesites and basalts.

The Association of the Gasteropod Genus Cyclora with Phosphate of Lime Deposits: By A. M. MILLER. Several specimens of phosphate rock examined showed numerous shells of *Cyclora.* The analysis of the rocks as a whole gave varying percentages of P_2O_5 and $Ca_3(PO_4)_2$, while analyses of the *Cyclora* casts showed them to contain a much larger amount of these compounds. In one case 89 per cent. of the material of the casts was found to consist of these compounds.

The Buchanan Gravels: An Interglacial Deposit in Buchanan County, Iowa: By SAMUEL CALVIN. These gravels in their typical exposures form beds ten to fifteen feet in thickness, lying above the Kansan drift and below the Iowan. The contrast between the hard undecayed boulders of the Iowan drift and the decayed boulders of the Buchanan gravels and Kansan drift is striking. These gravels are made up of materials derived from the older drift and were probably laid down in water immediately behind the retreating edge of the Kansan.

Lacroix' Axial Goniometer: By N. H. WINCHELL. This paper describes and figures a comparatively simple apparatus for easily measuring the optical angle of a mineral; it can be adjusted to any microscope, being inserted in the top of the body tube, and gives the optical angle measured in air.

Phenomena of Falling Meteorites: By O. C. FARRINGTON. The author discusses the explosions of meteorites and the sounds which accompany the fall of these bodies. Evidence is given which shows that meteorites sometimes do explode, producing marked detonations.

Philadelphia Meeting of the Geological Society of America: By WARREN UPHAM. An account of this meeting is given, together with abstracts of all the papers presented and also abstracts of the discussions following the papers.

Under 'Editorial Comment' notice is made of Prof. James Hall's gold medals, of the Transvaal gold region, and of the geological map of Europe prepared by the International Congress of Geologists. Under 'Personal and Scientific News' abstracts are given of geological papers presented at recent meetings of various scientific societies.

SOCIETIES AND ACADEMIES.

THE SCIENTIFIC ASSOCIATION OF THE JOHNS HOPKINS UNIVERSITY, DECEMBER 19.

ONE hundred and twenty-third regular meeting, December 19, 1895. President Remsen in the chair.

The following papers were presented and read:

1. *Theories of Color Sensation and of the Perception of Sound:* By W. J. MATHER.

Mr. Mather gave a brief review of the older theories of color perception, followed by a careful discussion of the present state of our knowledge of this suject. He dwelt especially upon the theories of Mrs. Franklin.

2. *Recent Work on Impregnation in Flowering Plants:* By J. E. HUMPHREY.

Mr. Humphrey showed that until about four years ago impregnation in flowering plants was known to take place only by the growth of the pollen tube across the cavity of the ovary and through the micropyle left by the coats of the ovule. In 1891 Treub described impregnation in Casuarina, the Australian iron-wood, by the downward growth of the pollen-tube through the tissue of the ovary to the chalaza, or stalk of the ovule, and its upward growth through the body of the ovule to the egg-cell. In 1894 Miss Benson found the same thing to occur in several English catkin-bearing plants, the hornbeam, the alder, the hazel, etc.

Nawaschin has just published the results of his studies of the white birch, which agrees closely with the alder. In attempting to explain chalazal impregnation, he points out that the entire course of the pollen-tube of the Gymnosperms is through tissue. He thinks that in the primitive Angiosperms, the descendants of the Gymnosperms, the tube has not yet acquired the ability to grow across open spaces, and therefore takes the indirect route which enables it to make its whole course through tissue. He also announces that the elm constitutes an intermediate form between those with chalazal and those with the micropylar impregnation.

Much work on this line is yet to be done, which may throw light on relationships among flowering plants.

On motion the meeting adjourned.

JANUARY 23.

ONE hundred and twenty-fourth regular meeting, January 23, 1896. President Remsen in the chair.

The following papers were presented and read:

1. *The Temperature of the Earth's Interior:* By G. K. GILBERT.

The speaker first pointed out the difficulty attending any investigation of the earth's interior, and stated that in the present condition of physical science all estimates of interior temperature are necessarily founded on questionable postulates. He then gave the results of a series of computations of the average temperature, each starting with a group of postulates.

2. *The Effect of Pressure on the Wave-Lengths of Lines in the Arc-Spectra of Certain Elements:* By J. F. MOHLER.

Mr. Mohler first pointed out that these wave-lengths had been considered as constants, and that it had even been proposed to use them as fundamental standards of length. This was followed by a detailed account of a series of experiments carried on in the Physical Laboratory of the Johns Hopkins University, which clearly establish the fact that these wave-lengths vary with the pressure. Pressures as high as twelve atmospheres were used. Diagrams were exhibited showing the results of the investigations.

The following papers of research were then presented and read by title:

1. *On Infinite Products:* By A. S. CHESSIN. (University Circulars: J. H. U.)

2. *Additional Note on Divergent Series:* By A. S. CHESSIN. (Bull. Am. Math. Society.)

On motion the meeting adjourned.

CHAS. LANE POOR, *Secretary.*

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met January 1st, forty-three persons present.

Prof. W. O. Crosby and Mr. A. W. Grabau showed that the chief deposits of modified drift in and about the Boston Basin could be referred to a connected chain of glacial lakes along the southern and western borders of the basin. These lakes existed between the receding margin of the ice sheet and the watersheds of the streams tributary to Boston Harbor, and, after the manner of lakes of this class, they were, through the continued recession of the ice margin, somewhat migratory in character and subject to great variations in outline, area, and level. During the period of the maximum and most interesting development of these lakes, the general trend of the ice margin was east-west along the southern border of the basin and north and northwest across the western end of the basin from the western end of the Blue Hills to the highland of Weston and Waltham; the ice, in accordance with the well established principles governing the motion of an ice sheet, having lingered on the depressed areas of the Boston Basin and Boston Harbor after it had disappeared from the relatively high land forming the western border of this great trough.

Along the south side of the basin, in Hingham, Weymouth, Braintree, Randolph, and Quincy, was formed Lake Bouvé (named in honor of Mr. T. T. Bouvé, a former President of the Boston Society of Natural History), some twelve miles in length. Its different levels, as determined by successive outlets, first south into North River and later east into Cohasset Harbor, were approximately 140 feet (Liberty Plain), 70 feet (Glad Tidings Plain), and 50 feet (Lower Plain). Other glacial lakes were formed in the upper basins of the Neponset and Charles Rivers. At their highest levels (240 to 300 feet) these were independent and tributary, respectively, to the Taunton and Blackstone Rivers. But at the level of 200 feet they were confluent and had a common outlet into the valley of Taunton River. Still later an outlet was opened eastward along the south side of the Blue Hills into Lake Bouvé at a height of about 160 feet. The plains formed during this stage of the Charles-Neponset Lake extend eastward across Wellesley and Needham into Newton and West Roxbury, and northward across the broad water-parting (now occupied by Lake Cochituate) between the Charles and Sudbury Rivers, and thence, apparently, down the valley of the Sudbury and Concord Rivers into Billerica.

The western edge of the great angle or lobe of the ice sheet naturally receded eastward more rapidly than the southern edge receded northward, and so it happened that the ice continued to form a solid barrier across Boston Harbor after it had disappeared from all the country between the Blue Hills and Arlington Heights. The drainage of the Neponset and Charles Basins thus eventually became tributary to Lake Bouvé along the north side of the Blue Hills, at the height, first, of Glad Tidings Plain, and, later, of Lower Plain. Plains of these heights have an extensive development in the lower valleys of the Charles and Neponset Rivers, across the site of Boston, and also in the upper valley of the Mystic River, outlining a body of standing water, which it is proposed to call Lake Shawmut, from the Indian name for Boston.

When the front of the ice sheet receded from the high land terminating in Fox Hill, northeast of Billerica Center, the drainage of the Concord, Merrimac, and Shawsheen Valleys probably found an outlet southeastward, along the course of the Boston and Lowell Railroad and the old Middlesex Canal, into the valley of the Mystic, and thence through Lake Shawmut and Lake Bouvé to Cohasset Harbor. In the glacial lake thus conditioned north of the Mystic water-parting were deposited the extensive plains having a normal height of about 100 feet, which stretch across Wilmington, northern Billerica, Tewksbury, and Lowell. It is very probable, also, that later a part of this northern drainage found its way southward through the valleys of the Malden and Saugus Rivers.

SAMUEL HENSHAW,
Secretary.

NEW YORK ACADEMY OF SCIENCES, BIOLOGICAL SECTION. JANUARY 13.

THE papers presented were:

G. S. HUNTINGTON, '*On The Visceral Anatomy of the Edentates.*' The characters of the brain, alimentary, respiratory and genito-urinary tracts were especially considered. The following forms were discussed: *Myrmecophaga jubata, Tamandua bivittata, Arctopithecus didaclylus, Dasypus sexcinctus, Tatusia novemcincta, Manis longicandata.* In the brain characters the following features were considered: the transverse frontal sulcus, the great longitudinal fissure, and the absence of a distinct Sylvian fissure. In the alimentary tract the Sloths are to be sharply separated from the remaining groups, the stomach structure with its pyloric gizzard notably aberrant: the ileo-colic junction is traced throughout the Edentates in a well marked series of transitional forms.

O. S. STRONG, '*On the Use of Formalin in Injecting Media.*' The paper made especial note of the advantages posessed by this preservative in injecting in brain in situ. Formalin (40% formaldelyde) diluted with an equal volume of water is injected into the cephalic vessels until it runs from the cut jugulars. After a few minutes the same quantity is again injected, and once or twice again after an elapse of fifteen to twenty minutes. The brain is then removed and will be found to be completely fixed throughout. The swelling usually noticed in formalin hardened brains does not appear to take place when this method is employed. Besides the many general advantages of fixing brains by injection, formalin has the especial merit of giving them the best consistency for microscopic work, and further, such brains are available subsequently for the Golgi and Weigert methods, as well as possibly for cytological methods. Formalin also has the advantage that it can be used, as above, stronger than is necessary for fixation and thus allowance made for its dilution when permeating the tissue. When only the Golgi method is to be used, an equal volume of a 10% solution of potassium bichromate may be added to the formalin instead of water. Pieces may be subsequently removed, hardened further in formalin-bichromate and impregnated with silver.

BASHFORD Dean, '*On the Supposed Kinship of the Paleospondylus.*' A favorably preserved specimen of this interesting fossil, received by the writer from Wm. T. Kinnear of Forss, Scotland, appears to warrant the belief that this lamprey-like form was possessed of paired fins, a character decidedly adverse to the now widely accepted view of Marsipobranchian affinities. The structure referred to consists of a series of transversely directed rays, arising from the region of the postoccipital plates of Traquair. From this peculiar character, as well as from many unlamprey-like features of the fossil, it would appear accordingly that the kinship of the Paleospondylus is as yet by no means definitely determined.

C. L. BRISTOL,
Secretary of Section.

JANUARY 13, 1896.

SECTION OF GEOLOGY AND MINERALOGY.

AT the meeting of the section of Geology and Mineralogy of the New York Academy of Sciences held January 20th, Prof. J. J. Stevenson in the chair, the following papers were presented:

The first, by E. O. Hovey, described the new and remarkably fine specimens of rare minerals recently discovered by Mr. Niven in the upper part of New York City. A doubly terminated tourmaline, $9\frac{1}{2}$ inches long by $4\frac{1}{2}$ inch diameter, was shown, and also unusually large samples of xenotime and monazite. The largest xenotime was $\frac{3}{8}$ of an inch in diameter, the monazite was about $\frac{5}{8}$ of an inch on the long edge. Fuller details regarding the crystallography appear in the Bulletin of the American Museum of Natural History of recent date. The specimens are now in the museum.

The second paper was by J. F. Kemp and T. G. White, and brought out the results of further exploration in the Adirondacks, the Lake Champlain Valley and the Green Mountains as regards the distribution of the trap dikes, well known from that region. One was cited on Mount McIntyre about 4,000 feet above tide, and others from various interior points in the Adirondacks. Microscopic study shows that they are in instances both camptonites and fourchites. This modifies the previous experience of Kemp and Marsters, who had found only diabase dikes in the Archean rocks. A great number of dikes were mentioned from the shores of Willsboro' Bay, on the New York side; one dike of camptonite was described from the granite quarries near Barre, Vt., and one from the Eustis pyrites mine, near Sherbrooke, Que. These outlying dikes materially extend the area in which they had been previously known. Very curious exposures were also described as having been recently uncovered in the Willard's Ledge quarries at Burlington, Vt. The paper concluded with some reflections on the petrology of the dikes. It will appear in full in the Transactions of the Academy.

The paper was followed by one by W. D. Matthew describing the metamorphism of Triassic coals at Egypt, N. C., by the intrusion of diabase dikes. Beginning with samples of coal at a distance of seventy feet from the dike it was shown that there is a progressive loss of volatile hydro-carbons as the igneous rock is approached, and that the bituminous coal passes into anthracite and this into prismatic coke next the dike. Geological sections and tables of analyses were shown. Attention was called to the fact that similar phenomena have been previously described from Virginia, but not from Egypt, N. C. The paper will appear in full in the Transactions of the Academy.

The last paper was by J. J. Stevenson on 'The Cerrillos Coal Fields near Santa Fé, N. M.' Prof. Stevenson brought out, by means of geological sections, that there were four coal seams contained between two laccolites of trachyte which had spread sidewise between the beds for nearly a mile from the parent dike or neck. In the topmost seam next the neck the coal was a graphitic anthracite passing, as the neck was left behind, into true anthracite, which graduated into semi-bituminous, and this into bituminous coking coal. The nearness of the laccolites appeared to exercise but little influence on the seams that were immediately over or under them, but the metamorphic change was due to the dike. The middle seam, which is at a maximum distance from the two laccolites, is bituminous coal throughout, so far as known, but it has not been worked near the dike. The speaker also referred to the change in our former ideas regarding the geology of the region, in that the intruded rocks have proved to be in two separate laccolites, where they were formerly thought to be in innumerable dikes. The paper was discussed by J. F. Kemp, who referred to the fact that the metamorphic changes were doubtless due to vapors or heated waters set in circulation by the dike; to which the speaker assented. The paper will appear in full in the Transactions.

J. F. KEMP,
Secretary.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular monthly meeting of the New York Section of the American Chemical Society was held at the College of the City of New York, 23d street and Lexington avenue, on Friday evening, January 10th.

Mr. G. C. Henning, M. E., delegate for the American Society of Mechanical Engineers, reviewed the 'Present Status of Iron and Steel Analysis,' calling attention to the discrepancies in some recent work of different chemists in determining the constituents of the same quality of steel, with special reference to carbon and phosphorus, and to the omission of the direct determination of iron, which he thinks conducive to overlooking such elements as titanium, tungsten and others, which are more often present than the usual iron analysis would indicate, as they are but infrequently determined directly.

He considers that the microscope has opened a field which marks a great advance in methods of determining the condition and quality of iron and steel, and thinks that chemical methods need great improvement to distinguish the conditions in which the carbon exists.

Mr. Rossi in discussing Mr. Henning's paper thought it would be very difficult, if not impossible, to recognize the different combinations of iron and carbon by chemical means, at least in the present state of chemical science, since there is so little outside of physical characteristics to distinguish them. In replying to these remarks, Mr. Henning said that several steel and iron companies in this country have already established very complete micrographic laboratories, where in three hours an accurate determination of the condition of any specimen of the daily output may be secured.

Papers were were read by Mr. G. C. Stone on 'The Probable Formation of Permanganates by Direct Combustion of Manganese' and 'Remarks on the Volhard Method of Determining Manganese;' by Dr. E. R. Squibb, on the 'Manufacture of Acetone and Acetone-Chloroform from Acetic Acid,' in which he reviewed the history of acetone from its first mention to the present date, and by Mr. J. S. Stillwell on Highly Compressed Gases.'

Dr. Squibbs showed that owing to the quotation, in standard works of reference, of erroneous results obtained by earlier experimenters, the progress of the manufacture of acetone had, for many years, been obstructed, and consequently the successful manufacture of chloroform from acetone had been correspondingly delayed.

Mr. Stillwell discussed the causes of explosion of cylinders of compressed gases with especial reference to those explosions which were supposed to result from the chemical combination of the compressed gas (oxygen) with oil or grease used as lubricant, and carried into the cylinders. He maintains that a temperature of 400° F. is required to produce such chemical combination, and that this temperature is never reached under normal working conditions.

DURAND WOODMAN,
Secretary.

GEOLOGIGAL SOCIETY OF WASHINGTON.

AT the 41st meeting of this Society, held in Washington, D. C., January 22d, two communications were presented, one by Mr. Arthur Keith, on the 'Crystalline Groups of the Southern Appalachians,' and the other by Prof. Chas. R. Van Hise, of the University of Wisconsin and the U. S. Geological Survey, on 'Primary and Secondary Structure and the Forces that Produced them.'

Mr. Keith described seven classes of formations, in which no sedimentary origin appeared. These comprised mica, gneiss and schist of three types, granite of five types, diorite of two types, gabbros of two types, peridotite and pyroxenite of five types, basalt and diabase of five types, andesite of two types, quartz porphyry and rhyolite of four types.

These formations occupy long narrow belts, comparable in extent with the sedimentary rocks, and belts of plutonic rocks alternate with volcanic rocks. Attention was called to the prevalence and attitudes of the schistose plane, due to deformation, and to the similar deformation of sediments and crystallines in the same area. The whole series of stratigraphic and structural results in sediments and crystallines was classified as part of the Appalachian system.

Prof. Van Hise discussed the relations of secondary structures to the forces that produced them, and it was concluded that there have been two entirely different structures described under the term 'cleavage.' Following the English geologists, it was held that one of these structures develops normal to the pressure in a deep-seated zone of rock flow, and that this ought properly to be called 'cleavage.' Following Becker it was held that there have often developed two intersecting structures on shearing planes in the zone of fracture. For this structure the term 'fissility' was proposed.

Mr. Becker, in discussing Prof. Van. Hise's paper, expressed himself as certain that true cleavages as well as ruptures are produced at large angles (not necessarily 45°) to the line of force. He regards the existence of such cleavages as well established, both by experiment and by theory. In his opinion, no adequate theoretical or experimental basis exists for asserting that cleavage is normal to force, and field observations on slates leave the exact direction of force to inference.

The communication, which was listened to with much interest, was illustrated by a number of diagrams.

On account of the importance of the subject it was proposed to invite Prof. Van Hise to give the Society a more extended presentation of it at the meeting to be held January 29th.

W. F. MORSELL.

INDIANA ACADEMY OF SCIENCE.

THE eleventh annual meeting of the Indiana Academy of Science was held at Indianapolis, December 27–28, 1895.

The meeting was quite largely attended and much interest was manifested. More than forty new names were added to our list of members.

The address of the retiring President, Mr. Amos W. Butler, on 'Indiana: A Century of Changes in the Aspects of Nature,' was intensely interesting and very instructive.

The papers were numerous and most of them of importance to the scientific work of the State.

The report of the Biological Survey on Turkey Lake deserves special mention. It indicated a great amount of work and will be productive of much good in creating a deeper interest in such work. Many papers ought to be mentioned, but space will not permit.

The officers for the next year are as follows: President, Stanley Coulter, Purdue University; Vice-President, Thomas C. Gray, Rose Polytechnic; Secretary, John S. Wright, Indianapolis; Assistant Secretary, A. J. Bigney, Mooles Hill College; Treasurer, W. P. Shannon, Greensburg.

The Spring meeting will probably be held in connection with the Ohio Academy, near the State line.

A. J. BIGNEY,
Assistant Secretary.

NEW BOOKS.

Anleitung zur Mikrochemischen Analyse. H. BEHRENS. Hamburg & Leipzig, Leopold Voss. 1896. Pp. xiii+108. M. 5.

Handbook to the British Mammalia. R. LYDEKKER. London, W. H. Allen & Co. Limited. 1895. Pp. xiii+339.

The Elements of Physics, Vol. I., Mechanics and Heat. EDWARD L. NICHOLS AND WILLIAM S. FRANKLIN. New York and London, Macmillan & Co. 1896. Pp. xi+228. $50.

The Story of the Solar System. G. F. CHAMBERS. New York, D. Appleton & Co. 1896. Pp. 181. 40 cents.

Life, Letters and Works of Louis Agassiz. JULES MARCOU. New York and London. 1896. Vol. I., pp. ix + 303; Vol. II., pp. x + 318. $4.00.

Old Faiths and New Facts. WILLIAM W. KENSLEY. New York, D. Appleton & Co. 1896. Pp. 345. $1.50.

Studies of Childhood. JAMES SULLY. New York, D. Appleton & Co. 1896. Pp. viii + 527. $2.50.

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*A MEMORIAL APPRECIATION OF CHARLES VALENTINE RILEY.**

THE name of Charles Valentine Riley is known in every part of the world where there are naturalists or intelligent agriculturists. His contributions to biological science and to agricultural economy were extensive and important, and were very highly esteemed abroad as well as at home.

At the time of his death he was fifty-two years old. Those who have known him only in recent days cannot have a full appreciation of many of his most characteristic and attractive traits. During the last ten years, worn out by intense devotion to his work, his energies exhausted by incessant application, his nervous vitality depleted by the friction of a long and arduous official career, though still remarkable for his force and productiveness, he was by no means the same as in the fourth decade of his life.

When, in 1894, he resigned his position as chief of the Bureau of Entomology, it was the belief and hope of his friends that, relieved from the official burden which had become so irksome to him, he would be able to devote the remainder of his life entirely to scientific pursuits. With his vast learning, his experience as an investigator, and the opportunities for leisurely study

* Presented at the annual meeting of the Joint Commission of the Scientific Societies of Washington, January 18, 1896.

which he possessed, it seemed as if the most useful period of his life was just about to begin. Many who are here present will remember the dinner given in his honor shortly after his fiftieth birthday, and how bright and promising his future then seemed. His untimely death prevented the realization of our anticipations; but yet, now that we can survey his career and review with care his achievements, it does not seem credible that they are those of one suddenly cut down in the prime of his life.

They are rather those of a man who, having lived to a good old age, had accomplished the work of fully two men during each year of his activities.

His energy was boundless and untiring; he did with ease and facility whatever he attempted, and rarely failed to accomplish that which he had undertaken to do; he had rare ability in selecting and training men to do the work for which he had himself no time, and in directing their labors towards the speedy attainment of results.

He acquired in early life those habits of feverish and restless activity which are characteristic of many of our countrymen, and which, though they contributed materially to magnify the results which he accomplished within comparatively few years, undoubtedly shortened the period of his usefulness.

The vast amount of work which he accomplished is shown by the catalogue of his published papers, of which there are more than 1,600, many of them of very considerable extent, and the whole equivalent to at least 20,000 octavo pages.

Professor Riley was a man of singularly striking appearance and agreeable presence. No one who had once seen him could forget him. Active and graceful, his bearing was such that, though perhaps not more than five feet ten inches in height, he seemed much taller. He never lost the easy, independent carriage which he had acquired during his early life in the West, and there was always something unconventional and picturesque about his costume and appearance. The broad-brimmed, sombrero-like hat, dark in winter, light in summer, which he almost always wore, seemed in keeping with his swarthy complexion. He looked like an artist or a musician, and indeed he possessed the artistic temperament in a high degree. As a youth he was urged to make painting his profession. In early years he drew thousands of illustrations of insects, which were characterized as much by beauty and delicacy of line as by minute accuracy. In later and busier times his taste for form and color were chiefly gratified in his favorite recreation of gardening. He was a most accomplished horticulturist, and his garden on Washington Heights was the best kept and most beautiful in the city, and gave evidence of the control of a master mind.

Riley was a thorough American in habits of thought and in sympathy, yet he often visited the little village of Walton, on the banks of the Thames, where he had passed the earlier years of his life. In these visits he learned something of his forefathers. His peculiar Southern features, his warm complexion, his dark eyes and hair, which made many people suppose him to be a Spaniard or an Italian, were derived from a more northern Celtic race, his ancestors, whose history he succeeded in tracing for many generations, having migrated from Wales to England at quite a recent day.

His schoolboy days were passed in France and Germany, and he was but seventeen when his restless spirit led him America.

"He went West and settled with Mr. G. H. Edwards, whom he had met in London and who had made arrangements to open a stock farm in Kankakee county, Illinois. Here, during three years, he acquired that experience of Western agriculture that can be gained only by actual farm work. Fond of all life as manifested on the farm, young Riley devoted himself enthusiastically to the calling he had chosen.

Of an inquiring and experimental turn of mind, he aimed to improve on the methods in vogue, and soon won the esteem of all who knew him ; and, though so young, was sought for in counsel and honored at public gatherings, at which he became intimate with Emory Cobb and other prominent farmers of Illinois. Under these circumstances, and with a deep love of nature in all her manifestations, it is no wonder that Professor Riley, as we have heard him avow, looks back to the farming days in Illinois as the happiest of his life.

"The experience gained on the farm has enabled him, more than anything else, to understand the position and needs of the farmer. In writing of Prof. Riley's farm life and the reasons why he abandoned it, a Kankakee friend who knew him well, remarks: 'Young Riley was simply too enthusiastic and too bent on excelling in everything. He took no rest. Often he would be up, actually get breakfast ready to relieve the womenfolk, and milk half a dozen cows before the others were about. When others were resting at noon in the shade, he would be working at his flowers under a July sun. There was not a sick animal of the three hundred on the place that he did not understand and help. He kept a lot of bees, got hold of the best bred colts and some of the best heifers in the county, secured a good quarter section, and spent his Sundays reading, sketching, and studying insects. Three years of this increasing effort under the trying climatic extremes of central Illinois broke the young fellow's health, for it was a great contrast to his previous life, and with every one telling him that he was wasting his talent he finally concluded to give up the idea of farming. But had his health not failed him, my opinion is that he would be a farmer to-day, and a successful one too, for he has intense love of rural life.'

"He went to Chicago in his twentieth year, with no definite trade or profession and with little experience of city life. Money was scarce among farmers in those days, and his little property was so invested that it was not available. The trials of his first few months in Chicago are familiar to only a few of his intimate friends, but the manner in which he overcame them while yet in but poor health was characteristic. Pride prevented him from asking help from his Kankakee friends, but did not prevent him from donning blue overalls and doing manual labor in a pork-packing establishment, or from adding to his slender income by making portraits of fellow-boarders, or sketches which he himself disposed of at evening in the abodes of wealth on Michigan avenue. After a while he obtained an engagement as reporter on the *Evening Journal*, but finally became connected with the *Prairie Farmer*, then the leading agricultural paper of the West. Besides a close application to the duties of his position as reporter, delineator and editor of the entomological department of this paper, he devoted his time and energies to the study of botany and entomology. His industry and versatility soon made him not only popular with his associates upon the paper, but gave him a widespread reputation as a writer upon natural history, especially on his specialty of economic entomology, the importance of which he soon made apparent." *

His adventurous temperament led him to enlist as a private in the 134th Illinois Volunteers, in which he served for several months during the Civil War in Kentucky and Tennessee.

Before entering the army he had made the acquaintance of the man whom he joined in 1868 in establishing the *American Entomologist.* This friend, who was senior editor until his death, was Dr. Benjamin D. Walsh, State Entomologist of Illinois, and it was Walsh to whom Riley always alluded as his master and the man to whom he was most indebted for his early training and inspiration. Mr. Walsh was a graduate of the University of Cambridge, in the class with Darwin, a man of great and scholarly attainments and a most careful and painstaking investigator. During the few years of his residence in Illinois he had done much to develop the interest in economic entomology, which resulted in the establishment of the position of State Entomologist of Missouri in 1868, which was the beginning of Riley's public labors.

An important outgrowth of Riley's personal activity in connection with his official work was the formation of the Riley Collection of insects, upon which he began immediately after he left the army in 1864, and which at the end of twenty-five years included over 20,000 species, and over 115,000 mounted specimens, besides much other material. The collection is in many respects unique, especially so because of the complete manner in which the life-history

*Colman's *Rural World*, St. Louis, May 12, 1892.

of numerous individual species is represented. It is the legitimate outgrowth and complement of Riley's investigations, and is a voucher for the accuracy and fulness of his personal work in entomology. This collection he gave in 1882, without condition, to the National Museum, at that time without a collection of insects. His purpose in doing this was to place in the Museum a worthy nucleus, and to be instrumental in the formation of a collection which would be worthy of the Nation. He was appointed at once honorary curator of the department of insects in the Museum, and gave much attention to the department, which thereafter made rapid advances.

Professor Riley's first interest in the study of insects was from this standpoint of a field naturalist. He did little in systematic entomology; the species which he described were but few, and he was quite content to leave monographic and critical work to others. His tastes led him to study the life histories, to trace each form through all its transformations, to know its habits, its food and its manner of life; and to understand its relations to, and its influence upon, the plants among which it lives and upon which it feeds. To the fact that he knew thoroughly the life histories of so many insects was due the importance of his contributions to economic entomology; but he was by no means content, as I have said, with the results in this field, although his deep interest in agriculture and horticulture led inevitably to practical conclusions with regard to every species which he studied. His writings are full of important and original observations in pure biology, and constitute a mine of reference for zoölogists and botanists, especially those studying the subject of transformism or evolution. He was indeed one of the earliest American transformists. He published an early and appreciative notice of Darwin's work, and I have seen many letters addressed to him by Darwin. He was also the correspondent and friend of Alfred Russell Wallace, Herbert Spencer, Henry Bates and of other eminent workers in kindred fields.

His writings abound in decisions of the greatest interest to students of evolution. His papers on 'The Caprification of the Fig,' on 'The Yucca Moth and Yucca Pollination' and on 'Some Interrelations of Plants and Insects' were especially interesting.

The most important of his philosophic papers was his address on 'The Cause of Variations in Organic Forms,' which he delivered when Vice-President of the American Association for the Advancement of Science, in 1888.

Passing allusion may be made to his interest in other branches of science. He had great interest in mechanical devices of all kinds, and in 1869 read before the French Academy of Sciences a paper on 'The Perfecting of the Graphophone,' which was regarded in France as suggestive and original. His studies of the flight of insects led him to take great interest in the problem of artificial flight; and his own skill as a prestidigitator, in which he took great delight, induced him to give much attention to spiritualism, in which he was no believer, but which attracted him on account of his own success in exposing frauds. During the last visit to Washington of Alfred Russell Wallace, who was a believer in spiritualism, he succeeded in proving impositions on the part of certain mediums whom the English philosopher was disposed to trust.

His standing as a naturalist was so high that three years ago, when the Hope professorship of entomology in the University of Oxford became vacant through the death of Professor Westwood, he was one of the two most prominent candidates for this position and failed of election by only a few votes. Indeed, it was known to have been Professor Westwood's own wish that Riley should be his successor.

He was greatly interested in the establishment of an insectary, in connection with the Smithsonian Institution, where, in connection with his museum work, he might carry out still further his investigation into the life history of members of his favorite group.

It was as an economic entomologist that Riley was most widely famed. In this field he was eminent in two respects—in administration, as well as in his direct contributions to the science of practical entomology, and to the art which is its outgrowth.

As an administrator, he was associated with three prominent undertakings: the entomological work of the State of Missouri, the United States Entomological Commission, and the establishment of the division of entomology of the Department of Agriculture.

He held the position of entomologist to the State of Missouri for nearly ten years, entering upon this work at the age of twenty-three. Concerning what he accomplished and how he did it, I shall allow one more competent than myself to speak:

"In the spring of 1868 his writings upon injurious insects brought about his appointment to the newly created office of entomologist to the State of Missouri, and from that time until 1877 he was engaged in the investigation which thoroughly established his fame. During that period he published nine annual reports, which have become classics in entomological literature. At the time when his work was begun, the science of practical entomology was in its infancy. The writings of Harris and Fitch had resulted in the tracing of the life-history of many of the principal injurious insects, but the recommendations as to the remedies were more or less crude, many important points were left uninvestigated, even with the commonest crop enemies, and a few entirely erroneous conclusions had been reached. Beyond the work of these two men, practically nothing had been done except the first report of Benjamin D. Walsh, which had just appeared.

"Looking back over Professor Riley's work during these years, one cannot help being amazed at its extent and character, especially when one considers that he worked single-handed, had many obstacles to overcome, and great demands upon his time in the way of correspondence, lectures and addresses. Every insect which he took up (and he published upon an immense number, including all that were then of great importance) was treated from a standpoint of absolute originality. The statements were based upon actual field observation, and the remedies proposed were the results of experiment or deductions from a perfect knowledge of the insects' habits and life history. In fact, it is no exaggeration to say that the modern science of economic entomology is based upon and dates from the publication of these reports.

"The original edition of these reports has long since been exhausted, but they are still continually sought for and command high prices. They are replete with the results of original research, and their illustrations created an epoch in the science no less than their text. The reports of the State Board of Agriculture containing them have long been sought by book dealers, who detach the entomological portions and sell the rest to junk dealers.

"Of these Missouri reports the late Charles Darwin wrote that they contained a vast number of facts and generalizations valuable to him, and that he was struck with admiration at the author's powers of observation."*

The United States Entomological Commission was in existence for five years, Riley having having been its chief from the beginning.

"We all remember," said the *Pacific Rural Press* in 1887, "the sad experiences which our Western States and Territories passed through from 1873 to 1877, from locust or grasshopper ravages, which resulted in destitution and precipitated a financial crisis. These ravages seriously affected the western portion of his own State, and Prof. Riley took hold of the problem with that originality and vigor which have characterized all of his work. His last three reports to the State contain the first positive and accurate knowledge on the subject that has been published. But he early saw that the subject was one of National importance, and could not be fully dealt with by work

*L. O. Howard, A Distinguished Entomologist, *The Farmers' Magazine*, London, I., 23, F.

in any one State. To feel a necessity was sufficient for him to act, and consequently we find him in public lectures, in leading articles, through resolutions offered at societies' meetings, memorials to Congress, and in every other way urging the creation of a National Entomological Commission. After various bills had been introduced and discussed, Congress finally created the Entomological Commission, with a special view to investigate the Rocky Mountain locust, or so-called grasshopper, and Prof. Riley was tendered the position as Chief of the Commission, a distinction which his investigations into this insect had justly earned, for he had already not only made most important discoveries as to its habits and the best means of subduing it, but had ascertained sundry laws that govern it, so as to be able to predict the time of its coming and going and the limits of its spread. Consulted by Secretary Schurz as to the other appointments, it is no wonder that the members chosen were Doctor A. S. Packard, Jr., a naturalist of eminence, one of the first entomologists of the world, and a prominent author and editor, and Prof. Cyrus Thomas, who had likewise labored for the creation of the Commission and who was the authority on the family of insects to which the locusts belonged. Both of these gentlemen, like Prof. Riley, had been chosen by their respective States as official entomologists, and had a large personal experience in the West. Accepting charge of the Commission thus constituted in March, 1877, we find Riley travelling that year over most of the Western country, from the Gulf to the South Saskatchawan, in British America, now in company with the Governor of the State, and again with other special officials, but everywhere exhorting the farmers to action, making careful observations and experiments, and inspiring confidence."

The work of the Commission was carried on with all the originality and vigor which charàcterized his work, and its annual reports contain a mass of important results, embodying the first real and definite knowledge on the subject which had seen the light of print. One of his associates writes:

"It was mainly owing to his executive ability, business sagacity, experience in official life, together with the scientific knowledge and practical inventive turn of mind in devising remedies, or selecting those invented by others, that the work of the Commission was so popular and successful during the last five years of its existence."*

The publications of the Commission consisted of five illustrated reports and seven bulletins. Of the former, Riley, himself, wrote that "the five taken together represent an amount of original investigation and experiment, the practical outcome of which has certainly never been excelled in the annals of economic entomology." In these reports were discussed not only the Rocky Mountain locust and its allies, but the cotton worm, the Boll worm, the army worm, the cankerworms and insects injurious to forest trees.

The position of of United States Entomologist was held by him during fourteen years, or from 1878, with a brief intermission, until nearly the time of his death; and during the period of his incumbency the Division of Entomology was organized. His successor in this position wrote in 1890:

"The present efficient organization of the Division of Entomology was his own original conception, and he is responsible for its plan down to the smallest detail. It is unquestionably the foremost organization of its kind at present in existence. It has a small permanent corps of scientific workers, who have been trained under him and who assist in the preparation and editing of reports, in the care of insects, the life-histories of which are being studied, in the making of elaborate notes, in the mounting and arranging of specimens for permanent economic and classificatory collections, in making drawings for illustrations to the reports and in the very large correspondence. The training of these assistants and their present efficiency and standing in the scientific world is only another

*A. S. Packard, SCIENCE, N. S., II., 74, F.

instance of the thoroughness of Prof. Riley's methods. Several of them have gone out from this office to accept important positions under the State governments, and thus the influence of his training has become widespread."*

His achievements in the art of practical entomology were many, but these were they which have been recognized as of especial and permanent value.

He was the first to demonstrate the practicability of checking the ravages of an imported species of insect by enlisting the aid of the insect enemies which had kept it in check in its native habitat. This was effected by the introduction from Australia, in 1888, at his instance and by two agents sent out from his office, of the Australian *Vedalia*—a species of lady-bird, which is the natural enemy of the 'Fluted Scale' an insect which had found its way from Southern Australia to California, and was fast destroying the orange and lemon groves.

His studies in connection with *Phylloxera*, the French vine pest, although not more important than many others more purely American in interest, may well be referred to on account of the attention which they attracted in France and honors conferred upon him as a result. To him is generally attributed the idea of reviving etiolated French vineyards by using certain American phylloxera-proof stocks to graft upon. In a sketch recently published by Monsieur Valery Mayet, in the *Revue de Viticulture*, certain statements are made which I quote:

"This notice being written especially for grape culturists, especial mention should be made of Riley's work upon insects destructive to the grape vine.

"From 1866 to 1884, during which time Riley made numerous visits to France, there appeared a constant succession of notes and articles upon insects inimical to the vine, and especially upon *Phylloxera*. Riley was, most certainly, one of the very earliest investigators on this subject, and long before he discussed the insect in Europe, he published in the *Prairie Farmer*, of August 3, 1866, a description of the insect, the first good description, since as he remarks, 'It had before been described only very briefly by Dr. Fitch, in New York, in 1856, under the name of *Pemphigus vitifolii*.'

"As soon as the *Phylloxera* had been discovered in France; in 1868 Riley began a correspondence with the three naturalists who were especially interested in this insect, J. E. Planchon, Lichtenstein and Signoret. He even visited France in this connection. The first idea suggested to his mind was to compare the American species with that of Europe. 'Lichtenstein and I' wrote Planchon in 1865, 'had the idea that the *Pemphigus vitifolii* of Fitch was nothing but our *Phylloxera vastatrix*. This theory was confirmed as soon as Riley, coming for that express purpose to Europe, assured us of the identity of the insects of the two countries.' Riley, on the other hand, had remarked, in 1871:

"'The observations made by me in America and Europe, of the winged and wingless forms, leaves no doubt in my mind that the insects of the two continents are identical.'

"The successive notices published by Riley, from 1868 to 1880, upon the insect, which for a long period of time prevented the culture of the European vine in the United States, a series of notes, not less than fifty-five in number, demonstrated the important connection of this naturalist with this very important question. His name soon became as popular in America as that of Planchon in France."*

As long ago as 1873 the vine-growers of France presented him with a gold medal, struck in recognition of his investigations into the history of the Phylloxera. In 1889, as a further proof of their appreciation of his services, they presented to him a beautiful statue in bronze, while the French government conferred upon him the Cross of the Legion of Honor.

Associated prominently with his name are certain practical methods for the destruction of insects, the use of kerosene emulsions to protect plants and trees from the attacks of suctorial insects, and the invention and perfection, aided by Mr. W. S. Barnard, of a very ingenious series of mechanical devices for spraying insecticides and fungicides in a liquid form, often called the Riley system.

* Howard, *loc. cit.*

* Revue de Viticulture.

It may perhaps be unwise to ignore the fact that the credit of certain of Riley's achievements has been claimed by others, in some instances by those who were first to call attention to facts out of which these achievements have grown, in other instances by those who were employed by Professor Riley to carry his ideas into effect.

It would be fruitless to enter into the consideration of any of these claims. Some of the claimants are perhaps entitled to a larger share of credit than has been given them in the official publications in which the results of their work are discussed. It is doubtful, however, whether in any instance any other would have succeeded so soon, or so completely as did Riley. His, in every instance, was the directing mind. It was he who chose the man through whose agency the work was accomplished. It was the mind of Riley which directed, and the will of Riley which controlled, the activities of his agents. It is my honest conviction that in most instances the agents would neither have begun the work under other circumstances, or completed it, except under such control, and that he was able to have done the work unaided, the results of his first years' efforts, when he was laboring single-handed, fully demonstrate.

There cannot well be better evidence of the eminence of the man and the value of his work than the testimony of the numerous journals in their comments upon his death, and especially the journals which are devoted to ecomonic methods rather than those of the professional men of science.

The *Canadian Entomologist*, London, Ontario, said:

"'As an economic entomologist, taking him for all in all, he was the most eminent the world has ever seen.'"*

Natural Science, London,† called him 'the prince of economic entomologists,' and says of his reports that they are "characterized by scientific accuracy coupled with clear and popular exposition, and while of special value to the farmer, fruit grower and forester, they abound with observations of interest to the pure naturalist."

* *Canadian Entomologist*, October, 1895, 273.

† *Natural Science*, November, 1895, 360.

Psyche, Cambridge, said:

"In his death America loses not only its best known entomologist, but one who by his ability, sagacity, example and the line his studies have taken, has done more for the advancement of our special science than any one America has ever reared." *

The editor of *The Farmers' Magazine*, of London, wrote:

"His studies of Hessian-fly and the Hop-fly, in England, have a direct bearing upon our agricultural prosperity, and his election as an honorary member of the Royal Agricultural Society, and still more recently as an Honorary Fellow of the Entomological Society of London, testify to the esteem in which he he is held, not only by our representatives of advanced agriculture, but also by those engaged here in investigations in the field of pure entomology." †

R. McLachlan, F. R. S., in the *Entomologists' Monthly Magazine*, London, said:

"The Missouri Reports proved the thoroughness of his work, his originality in divising mechanical means for distributing the remedial agents he adopted and his great skill as an artist. These Reports drew forth the highest encomiums all over the world. * * * Riley was nothing if not original. There was probably only one real *fiasco* in his career. The rapid spread of the Colorado Beetle induced him to predict its speedy appearance on this side of the Atlantic. The Colorado Beetle disappointed him by not acting up to his anticipations."‡

W. Fream, writing in the Journal of the Royal Agricultural Society of England, spoke of him as "the greatest agricultural entomologist of our age," and said:

"In him a striking presence was associated with a versatile genius. Naturalist, linguist, artist, soldier, he was withal a delightful companion, a sincere friend. In that branch of study which he made peculiarly his own he has established an ideal which few

* *Psyche*, November, 1895, p. 308.

† *The Farmers' Magazine*, I., 221.

‡ *Entomologists' Monthly Magazine*, No. 378, November, 1895, 269.

can hope to approach and none to excel. Taken from our midst in the early prime of life, it can nevertheless, with all truth, be said that in the voluminous records of his incessant work he has indeed left behind him *monumentum aere perennius.*"

G. BROWN GOODE.

SCIENTIFIC MATERIALISM.

AT the meeting of the Naturforscher-Versammlung, held last September, at Lübeck, Germany, Professor W. Ostwald, of Leipzig, delivered an address which was received with great interest, and gave rise to much discussion. The address has since been published in the *Zeitschrift für Physikalische Chemie* (Volume XVIII., p. 305), under the title 'Die Ueberwindung des wissenschaftlichen Materialismus,' and it seems desirable to call attention to it in this place, as it is highly suggestive, and its careful study is likely to be of benefit. The following is in the main a free translation of the more important parts of the address:

There is one point upon which scientific men agree, and that is that all things consist of moving atoms, and that these atoms and the forces acting upon them are the final realities. According to this, a natural phenomenon is explained when the exact nature of the motion of the atoms of the substance exhibiting the phenomenon is known. There is nothing beyond this. Matter and motion are ultimate conceptions. This is *scientific materialism*. The author believes that this view is untenable. It must be given up and a better view substituted for it. He states particularly that what he has to say has, at present, nothing to do with ethical and religious conceptions.

In investigating natural phenomena we first *register* and *classify*. From *registration* we reach the *system*; from this the *law of nature*, the most comprehensive form of which is the *general conception*. The most important element in the law is the *invariant*, a quantity that remains unchanged whatever changes may take place. Such an invariant is *mass*. This did not at first appear broad enough, and thus the conception of *matter* came to light, and the *physical law* of the *conservation of mass* was transformed into the *metaphysical axiom* of the *conservation of matter*. By this step a number of hypothetical elements are introduced into the conception that was originally free from hypothesis. It is now held that when, for example, iron and oxygen combine, the two forms of matter are in the compound, only they have new properties. This the author considers nonsense, for all that we know in regard to a certain stuff is that it has certain properties.

Galileo introduced the conception of the constant working *force* and thus explained the phenomenon of falling bodies. Newton assumed the same force as acting between the heavenly bodies and governing their motions. These great successes led to the conviction that all physical phenomena might be explained in the same way. Thus arose the *mechanical conception* of nature. It is not generally noticed to what an extent this conception is hypothetical, indeed metaphysical. On the other hand, it must be noted that this mechanical conception of heat, electricity, magnetism, chemism, has not been confirmed in a single case. It has not been possible to express the relations by a corresponding mechanical system, so that nothing is left unaccounted for.

The history of optics furnishes an excellent example. As long as optics included only the phenomena of reflection and refraction, the mechanical conception of Newton was satisfactory, according to which light consists of small particles sent out in straight lines. When later the phenomena of interference and polarization came to be studied, it was found that Newton's mechanical conception could not explain them, and the vibration theory of Huygens and Euler was adopted. But it was then necessary to imagine some medium which could transmit the vibrations, and thus the hypothetical ether took its place in the scientific mind. The phenomena of polarization require that the vibrations shall be transverse, and therefore the ether must be a solid. The calculations of Lord Kelvin have shown that a medium with properties, such as must be ascribed to the ether to account for the facts known, would not be stable, in other words, that it could not exist. Probably in order to save the electro-magnetic theory from a like fate, the immortal Herz, to whom this theory owes so much, expressly declines to see anything in it but a system of six differential equations.

The task of science is to find the relations that exist between realities, measurable quantities, so that when some are known others can be deduced. This idea is not new. Mayer, fifty-three years ago, discovered the equivalence of the natural forces, or, as we say to-day, of the different forms of energy. Then Clausius, Helmholtz and W. Thompson thought it necessary to interpret the law of the equivalence of the different forms of energy by assuming that all the different forms of energy are fundamentally the same, that is to say, *mechanical energy*. This was distinctly a backward step.

How is it then possible, by means of such an abstract idea as energy, to form a conception of the universe, which in clearness can be compared with the mechanical? What do we then know of the physical world? Plainly only that which comes to us through our sensory organs. What conditions must be satisfied in order that one of these organs shall be affected? We may turn the matter in any way we please, we find no common feature but this: The sensory organs are affected by energy changes between them and their environment. In a world, the temperature of which is everywhere the same as that of our bodies, we could not know anything of heat, just as we do not feel the constant atmospheric pressure under which we live. Only when we produce spaces with other pressures do we gain any knowledge of it.

It is often said energy is imaginary, while matter is the reality! The author answers: On the contrary, matter is a product of the imagination, that we have constructed very imperfectly in order to represent the permanent in the everlasting changes.

According to the author, matter and energy are not to be thought of as distinct, as for example, body and soul. If we attempt to think of matter as separate from the various forms of energy nothing is left. Matter is, in fact, nothing but a group of different energies arranged in space. He then makes use of this crude illustration. Imagine yourself struck with a cane. What do you feel, the cane or its energy? Of course, it is the energy. The cane at rest is harmless.

Everything that has hitherto been represented by the aid of the conceptions of force and matter, and much more, can be represented by means of the conception of energy. We make a great gain by indulging in no hypotheses in regard to the connection between the different forms of energy except that which is specified in the law of conservation, and we gain the freedom of studying the different phenomena objecttively.

Finally, it may be asked, is energy the last reality? However, necessary and useful for the understanding of nature energy may be, is there nothing beyond it? Or are there phenomena which cannot be fully expressed by the now known law of energy? The author expresses the belief that energy is not sufficient to enable us to deal with all nature. It will probably appear in the future as a special case of still more general relations of the form of which we have at present no conception.

In a later number of the *Zeitschrift für physikalische Chemie*, Ostwald reviews the second edition of J. B. Stallo's 'The Concepts and Theories of Modern Physics' that appeared in 1885, and expresses the hope that the book may find half as many readers as it deserves. The book was first issued in 1882 as one of the *International Scientific Series*, and scientific men as a whole regarded it unfavorably, though some of them certainly recognized the force of many of the author's arguments against the materialistic conceptions which were then and are now generally held.

IRA REMSEN.

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*ON A NEW KIND OF RAYS.**

1. A DISCHARGE from a large induction coil is passed through a Hittorf's vacuum tube, or through a well-exhausted Crookes' or Lenard's tube. The tube is surrounded by a fairly close-fitting shield of black paper; it is then possible to see, in a completely darkened room, that paper covered on one side with barium platinocyanide lights up with brilliant fluorescence when brought into the neighborhood of the tube, whether the painted side or the other be turned towards the tube. The fluorescence is still visible at two metres distance. It is easy to show that the origin of the fluorescence lies within the vacuum tube.

2. It is seen, therefore, that some agent is capable of penetrating black cardboard which is quite opaque to ultra-violet light, sunlight or arc-light. It is therefore of interest to investigate how far other bodies can be penetrated by the same agent. It is readily shown that all bodies possess this same transparency, but in very varying degrees. For example, paper is very transparent; the fluorescent screen will light up when placed behind a book of a thousand pages; printer's ink offers no marked resistence. Similarly the fluorescence shows behind two packs of cards; a single card does not visibly diminish the brilliancy of the light. So, again, a single thickness of tinfoil hardly casts a shadow on the screen; several have to be superposed to produce a marked effect. Thick blocks of wood are still transparent. Boards of pine two or three centimetres thick absorb only very little. A piece of sheet aluminium, 15 mm. thick, still allowed the X-rays (as I will call the rays, for the sake of brevity) to pass, but greatly reduced the fluorescence. Glass plates of similar thickness behave similarly; lead glass is, however, much more opaque than glass free from lead. Ebonite several centimetres thick is transparent. If the hand be held before the fluorescent screen, the shadow shows the bones darkly, with only faint outlines of the surrounding tissues.

Water and several other fluids are very transparent. Hydrogen is not markedly more permeable than air. Plates of copper, silver, lead, gold and platinum also allow the rays to pass, but only when the metal is thin. Platinum .2 mm. thick allows some rays to pass; silver and copper are more transparent. Lead 1.5 mm. thick is practically opaque. If a square rod of wood 20 mm. in the side be painted on one face with white lead it casts little shadow when it is so turned that the painted face is parallell to the X-rays, but a strong shadow if the rays have to pass through the painted side. The salts of the metal, either solid or in solution, behave generally as the metals themselves.

3. The preceding experiments lead to the conclusion that the density of the bodies is the property whose variation mainly affects their permeability. At least no other property seems so marked in this connection. But that the density alone does not determine the transparency is shown by

* From the translation in *Nature* by Arthur Stanton from the *Sitzungsberichte der Würzburger Physik-medic. Gesellschaft*, 1895.

an experiment wherein plates of similar thickness of Iceland spar, glass, aluminium and quartz were employed as screens. Then the Iceland spar showed itself much less transparent than the other bodies, though of approximately the same density. I have not remarked any strong fluorescence of Iceland spar compared with glass (see below, No. 4).

4. Increasing thickness increases the hindrance offered to the rays by all bodies. A picture has been impressed on a photographic plate of a number of superposed layers of tinfoil, like steps, presenting thus a regularly increasing thickness. This is to be submitted to photometric processes when a suitable instrument is available.

5. Pieces of platinum, lead, zinc, and aluminium foil were so arranged as to produce the same weakening of the effect. The annexed table shows the relative thickness and density of the equivalent sheets of metal.

	Thickness.	Relative thickness.	Density.
Platinum	·018 mm.	1	21·5
Lead	·050 "	3	11·3
Zinc	·100 "	6	7·1
Aluminium	3·500 "	200	2·6

From these values it is clear that in no case can we obtain the transparency of a body from the product of its density and thickness. The transparency increases much more rapidly than the product decreases.

6. The fluorescence of barium platinocyanide is not the only noticeable action of the X-rays. It is to be observed that other bodies exhibit fluorescence, *e. g.* calcium sulphide, uranium glass, Iceland spar, rock salt, &c.

Of special interest in this connection is the fact that photographic dry plates are sensitive to the X-rays. It is thus possible to exhibit the phenomena so as to exclude the danger of error. I have thus confirmed many observations originally made by eye observation with the fluorescent screen. Here the power of the X-rays to pass through wood or cardboard becomes useful. The photographic plate can be exposed to the action without removal of the shutter of the dark slide or other protecting case, so that the experiment need not be conducted in darkness. Manifestly, unexposed plates must not be left in their box near the vacuum tube.

It seems now questionable whether the impression on the plate is a direct effect of the X-rays, or a secondary result induced by the fluorescence of the material of the plate. Films can receive the impression as well as ordinarly dry plates.

I have not been able to show experimentally that the X-rays give rise to any calorific effects. These, however, may be assumed, for the phenomena of fluorescence show that the X-rays are capable of transformation. It is also certain that all the X-rays falling on a body do not leave it as such.

The retina of the eye is quite insensitive to these rays; the eye placed close to the apparatus sees nothing. It is clear from the experiments that this is not due to want of permeability on the part of the structures of the eye.

7. After my experiments on the transparency of increasing thicknesses of different media, I proceeded to investigate whether the X-rays could be deflected by a prism. Investigations with water and carbon bisulphide in mica prisms of 30° showed no deviation either on the photographic or the fluorescent plate. For comparison, light rays were allowed to fall on the prism as the apparatus was set up for the experiment. They were deviated 10 mm. and 20 mm. respectively in the case of the two prisms.

With prisms of ebonite and aluminium I have obtained images on the photographic plate which point to a possible deviation. It is, however, uncertain, and at most would point to a refractive index 1.05. No deviation can be observed by means of the fluorescent screen. Investigations with the heavier metals have not as yet led to any result, because of their small transparency and the consequent enfeebling of the transmitted rays.

On account of the importance of the question it is desirable to try in other ways whether the X-rays are susceptible of refraction. Finely-powdered bodies allow in thick layers but little of the incident light to pass through, in consequence of refraction and reflection. In the case of the X-rays, however, such layers of powder are for equal masses of substance equally transparent with the coherent solid itself. Hence we cannot conclude any regular reflection or refraction of the X-rays. The research was conducted by the aid of finely-powdered rock salt, fine electrolytic silver powder, and zinc dust, already many times employed in chemical work. In all these cases the result, whether by the fluorescent screen or the photographic method, indicated no difference in transparency between the powder and the coherent solid.

It is, hence, obvious that lenses cannot be looked upon as capable of concentrating the X-rays; in effect, both an ebonite and a glass lens of large size prove to be without action. The shadow photograph of a round rod is darker in the middle than at the edge; the image of a cylinder filled with a body more transparent than its walls exhibits the middle brighter than the edge.

8. The preceding experiments, and others which I pass over, point to the rays being incapable of regular reflection. It is, however, well to detail an observation which at first sight seemed to lead to an opposite conclusion.

I exposed a plate, protected by a black paper sheath, to the X-rays, so that the glass side lay next to the vacuum tube. The sensitive film was partly covered with star-shaped pieces of platinum, lead, zinc and aluminium. On the developed negative the star-shaped impression showed dark under platinum, lead, and, more markedly, under zinc; the aluminium gave no image. It seems, therefore, that these three metals can reflect the X-rays; as, however, another explanation is possible, I repeated the experiment with this only difference, that a film of thin aluminium foil was interposed between the sensitive film and the metal stars. Such an aluminium plate is opaque to ultra-violet rays, but transparent to X-rays. In the result the images appeared as before, this pointing still to the existence of reflection at metal surfaces.

If one considers this observation in connection with others, namely, on the transparency of powders, and on the state of the surface not being effective in altering the passage of the X-rays through a body, it leads to the probable conclusion that regular reflection does not exist, but that bodies behave to the X-rays as turbid media to light.

Since I have obtained no evidence of refraction at the surface of different media, it seems probable that the X-rays move with the same velocity in all bodies, and in a medium which penetrates everything, and in which the molecules of bodies are embedded. The molecules obstruct the X-rays the more effectively as the density of the body concerned is greater.

9. It seemed possible that the geometrical arrangement of the molecules might affect the action of a body upon the X-rays, so that, for example, Iceland spar might exhibit different phenomena according to the relation of the surface of the plate to the axis of the crystal. Experiments with quartz and Iceland spar on this point lead to a negative result.

10. It is known that Lenard in his investigations on cathode rays has shown that they belong to the ether and can pass

through all bodies. Concerning the X-rays the same may be said.

In his latest work Lenard has investigated the absorption coefficients of various bodies for the cathode rays, including air at atmospheric pressure, which gives 4.10, 3.40, 3.10 for 1 cm., according to the degree of exhaustion of the gas in discharge tube. To judge from nature of the discharge, I have worked at about the same pressure, but occasionally at greater or smaller pressures. I find using a Weber's photometer that the intensity of the fluorescent light varies nearly as the inverse square of the distance between screen and discharge tube. This result is obtained from three very consistent sets of observations at distances of 100 and 200 mm.; hence air absorbs the X-rays much less than the cathode rays. This result is in complete agreement with the previously described result, that the fluorescence of the screen can be still observed at 2 metres from the vacuum tube. In general other bodies behave like air; they are more transparent for the X-rays than for the cathode rays.

11. A further distinction, and a noteworthy one, results from the action of a magnet. I have not succeeded in observing any deviation of the X-rays even in very strong magnetic fields.

The deviation of cathode rays by the magnet is one of their peculiar characteristics; it has been observed by Hertz and Lenard that several kinds of cathode rays exist, which differ by their power of exciting phosphorescence, their susceptibility of absorption and their deviation by the magnet; but a notable deviation has been observed in all cases which have yet been investigated, and I think that such deviation affords a characteristic not to be set aside lightly.

12. As the result of many researches, it appears that the place of most brilliant phosphorescence of the walls of the discharge tube is the chief seat whence the X-rays originate and spread in all directions; that is, the X-rays proceed from the front where cathode rays strike the glass. If one deviates the cathode rays within the tube by means of a magnet, it is seen that the X-rays proceed from a new point, *i. e.*, again from the end of the cathode rays.

Also for this reason the X-rays which are not deflected by a magnet cannot be regarded as cathode rays which have passed through the glass, for that passage cannot, according to Lenard, be the cause of the different deflection of the X-rays. Hence, I concluded that the rays are not identical with the cathode rays, but are produced from the cathode rays at the glass surface of the tube.

13. The rays are generated not only in glass. I have obtained them in an apparatus closed by an aluminium plate 2 mm. thick. I propose later to investigate the behavior of other substances.

14. The justification of the term 'rays,' applied to the phenomena, lies partly in the regular shadow pictures produced by the interposition of a more or less permeable body between the source and a photographic plate or fluorescent screen.

I have observed and photographed many such shadow pictures. Thus, I have an outline of part of a door covered with lead paint; the image was produced by placing the discharge tube on one side of the door, and the sensitive plate on the other. I have also a shadow of the bones of the hand (Fig. 1); of a wire wound upon a bobbin; of a set of weights in a box of a compass card and needle completely enclosed in a metal case; of a piece of metal where the X-rays show the want of homogeneity, and of other things.

For the rectilinear propagation of the rays I have a pin-hole photograph of the discharge apparatus covered with black paper. It is faint, but unmistakable.

15. I have sought for interference effects of the X-rays, but possibly, in consequence of their small intensity, without result.

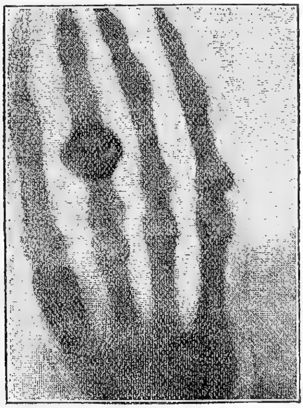

FIG. 1.—Photograph of the bones in the fingers of a living human hand. The third finger has a ring upon it.

16. Researches to investigate whether electrostatic forces act on the X-rays are begun, but not yet concluded.

17. If one asks, what then are these X-rays; since they are not cathode rays, one might suppose, from their power of exciting flourescence and chemical action, them to be due to ultra-violet light. In opposition to this view a weighty set of considerations presents itself. If X-rays be indeed ultra-violet light, then that light must possess the folling properties.

(*a*) It is not refracted in passing from air into water, carbon bisulphide, aluminium, rock salt, glass or zinc.

(*b*) It is incapable of regular reflection at the surfaces of the above bodies.

(*c*) It cannot be polarized by any ordinary polarizing media.

(*d*) The absorption by various bodies must depend chiefly on their density.

That is to say, these ultra-violet rays must behave quite differently from the visible, infra-red, and hitherto known ultra-violet rays.

These things appear so unlikely that I have sought for another hypothesis.

A kind of relationship between the new rays and light rays appears to exist; at least the formation of shadows, fluorescence, and the production of chemical action point in this direction. Now it has been known for a long time that, besides the transverse vibrations which account for the phenomena of light, it is possible that longitudinal vibrations should exist in the ether, and according to the view of some physicists must exist. It is granted that their existence has not yet been made clear, and their properties are not experimentally demonstrated. Should not the new rays be ascribed to longitudinal waves in the ether?

I must confess that I have in the course of this research made myself more and more familiar with this thought, and venture to put the opinion forward, while I am quite conscious that the hypothesis advanced still requires a more solid foundation.

W. C. RÖNTGEN.

RÖNTGEN RAYS.

PROFESSOR RÖNTGEN's discovery brings to a close a most interesting chapter in the history of electricity; it is the chapter dealing with electric discharges through rarefied gases. Experiments on electric discharges through vacua have for quite a long period now attracted the attention of physicists. Elaborate accounts of these experiments can be found in the transactions of learned societies throughout the last century. A systematic research into the various phenomena accompanying vacuum discharges dates from the time of Faraday. Plücker, Hittorf and Goldstein in Germany, and Spottiswoode and Crookes in England, may be mentioned as the foremost investigators who extended very much what Faraday had only commenced. Among the numerous, most interesting, and indeed remarkable, results obtained by these investigators, the behavior of the discharge, which under certain conditions, emanates from the negative electrode, the so-called cathode, was always considered as the most remarkable.

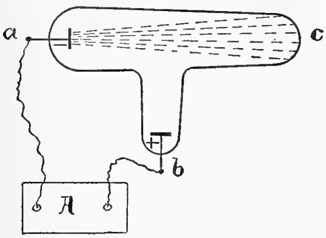

Fig. I. represents a typical form of the vacuum tube capable of showing a strongly developed cathode discharge. At *a* we have one electrode and at *b* the other. They consist of platinum discs attached to platinum wires which are sealed in the glass. Let the electrode *a* be connected to the negative, *b* to the positive pole of the induction coil A. As the air pressure in the tube is reduced, the color and the general appearance of the discharge continually changes character. When the pressure reaches a small fraction of a millimeter of mercury the intensity of the discharge in the gas itself becomes very much reduced, but in its place appears a strong fluorescence of the glass. This fluorescence is produced by faint streamers which proceed in straight lines from the negative electrode, as indicated by the straight lines in Fig. I., from the disc at *a* toward the terminal *c* of the tube. These streamers are called the cathode rays. Professor Crookes, of London, advanced the theory that the streamers represent a fourth state of matter, which he called radiant matter. According to this theory there is matter moving from the negative electrode, where it is projected by the action of electric force, and whenever this moving matter strikes the glass it causes it to fluoresce. A radiometer interposed properly in the path of the streamers will be set into rotation. The fact that the fluorescing portions of the tube become very hot when the action of the coil is powerful seemed to support Crookes' hypothesis, namely, that there is along the path of the cathode rays projected matter moving with very high velocity.

Other theories concerning these rays were proposed, but none of them are entirely free from serious objections. Röntgen's discovery will probably enable us to decide very soon which among the several existing theories is the correct one. The theory which probably has the most followers on the continent will be mentioned presently.

Cathode rays are deflected by magnetic force; the direction of the deflection is roughly stated the same as if each ray were a flexible conductor carrying a current with one of its terminals attached to the cathode. The late Professor H. Hertz discovered in 1891 that cathode rays are capable of passing through thin sheets of metal like gold leaf, aluminum, silver, etc., if these sheets are placed within the vacuum in the path of the rays. Dr. Lenard, an adjunct to Hertz, extended this discovery two years ago by showing that the cathode rays can be made to pass out of the vacuum tube into the external space, if the tube is provided with a small window of thin aluminum. But as soon as they pass into the external atmosphere they are rapidly absorbed; this absorption results in a flourescence of the gas. Various gases possess various degrees of this absorptive power and the absorption in a given layer of gas is proportional to its density. Solid bodies absorb them very much more strongly on account of the greater density. The resulting flourescence in gases seems to indicate that the cathode rays in passing through a gas undergo a diffuse reflection resembling the reflection in a turbid medium, just as if the molecules of the gas were very large in comparison to the wave-length of these rays. That the radiance which produces the fluorescence is really a continuation of the cathode rays is demonstrated by the fact that it is deflected by magnetic force.

Röntgen's discovery adds a new accompaniment to the cathode rays. It shows that, in addition to the heat and flourescent light which the cathode rays generate in the glass of the vacuum tube wherever they strike it, there is also another form of radiant energy generated there. Röntgen calls it the X-rays. The rays will and should, of course, be called the Röntgen rays. They are not cathode rays, according to the reports which have reached us so far; for although they are capable of producing strong flourescence, just like the cathode rays, they are not acted upon by magnetic force, and not only are they not absorbed by gases at ordinary pressure, but even the most opaque of all substances, that is the metals, are more or less transparent with respect to these new rays. Cardboard, wood, ebonite, organic substances, etc., are about as transparent to them as glass is to the visible part of the spectrum. They are neither reflected nor refracted, that is not to any appreciable degree. They act upon a photographic plate, but it is evident that photography by means of these rays cannot employ lenses and that the pictures obtained will be shadow pictures. The object to be photographed is placed between the plate and the vacuum tube. It is to to be hoped that these shadow pictures of the interior of living organisms will soon be perfected so as to show us the various parts in various shades according to the absorptive power of each part.

The question arises, what is this new form of radiant energy? The report says that the discoverer has expressed, but with much reserve, his belief that it is a longitudinal vibration of the ether. If so, then its velocity of propagation will in all probability be much larger than that of light, and therefore for the same period of vibration as that of visible light these new rays may have a very much larger wave-length. Should this belief of the discoverer prove correct, then we shall finally have the longitudinal wave in the ether for which we have looked so long, in order to avoid the necessity of considering the ether an incompressible solid elastic. It is well to mention here that quite a large number of very distinguished German physicists have within the last few years advocated quite strongly the theory that cathode rays are longitudinal vibrations of the ether. Prof. Jaumann, of Vienna, has published quite recently a very elaborate mathematical formulation of this theory. It is an application of Maxwell's electro-magnetic theory to a mediun whose specific inductive capacity and permeability vary under the action of electric force. Such a medium is in all probability a gas in a state of high tenuity, as for instance in a Crookes' tube. This theory will not account satisfactorily the longitudinal character of the Röntgen rays.

The correct view of this new radiant energy will undoubtly soon be formed when new experimental data appear. In the meantime we can rest assured that a new entrance to the region of the ether phenomena has been opened, and the importance of this fact can hardly be overestimated.

After the above note had been written the author succeeded in repeating some of Prof. Röntgen's experiments. The tubes employed were of an inferior quality on account of the poor vacuum. The poorer the vacuum the longer must be the time of exposure under otherwise identical conditions. The tubes were used as electrodeless tubes, that is, a tinfoil strip was wrapped around each end of the tube, and then the tinfoils were connected to a high tension coil with disruptive spark gap and Leyden jar. The vacuum discharge is, of course, in such cases due to the condenser effect. The writer's experiments lead to the conclusion that quite as powerful effects can be produced in this manner as with electrodes, and it obviates the risk of spoiling the tube by excessive heating of the platinum wires carrying the electrode discs. It is well to observe here that with electrodeless tubes the glass under the tinfoil becomes very hot indeed in quite a short time, when powerful, rapid electric oscillations are employed. But on account of the large tinfoil surface which is in contact with the outside air the temperature of the tube never becomes dangerously high. Some of the results of the writer's experiments seem to be of sufficient interest to deserve a brief mention here.

An under-exposed plate fails completely to bring out the relative absorption of the materials placed in the path of the rays. For instance, the photograph of a cigar box made of aluminium sheet about $\frac{1}{16}$ of an inch thick and containing several opaque objects will show no detail if the exposure is too short. All that we see is the contour of the box, and the area bounded by this contour is uniformly illuminated. With a sufficiently long exposure the contour is still strong, but the area enclosed by the contour is scarcely visible and the objects in the box appear in sharp outline. Various objects were photographed and the results were similar to those obtained by Professors Trowbridge and Wright. The most interesting photograph obtained was that of a pair of spectacles in a leather case (see Plate III., Fig. 1). It bears upon the subject mentioned in the last paragraph. The exposure lasted an hour; the tube had the highest vacuum among the several tubes employed. In all previous photographs the lenses of these spectacles appeared as perfectly flat discs of high opacity. In this photograph, however, obtained with long exposure, the varying thickness of the lens is beautifully marked in the negative. The central part of the lens is darkest, and then the increase in luminosity toward the edge was gradual, showing distinctly the curvature of the lens. This photograph seems to support the writer's belief that the relative amounts of absorption in the various parts of the object photographed are brought out in a photographic plate if it is exposed a sufficiently long time, but not otherwise. In the photography of the human hand, for instance, there is no trace of the skeleton unless the exposure is sufficiently long. The contour surrounding the uniformly illuminated surface of the hand is very easily obtained with a short exposure. But to obtain an image of the skeleton of the hand the exposure must be sufficiently long, and it appears that the longer the exposure the stronger is the impression of the contour of the bones and the weaker is that of the surrounding flesh.

Prof. Röntgen's photograph of the human hand is the only one in which the flesh is almost entirely invisible. In Mr. Swinton's photograph the fleshy part of the hand is nearly as strongly marked out as the bony part. The writer cannot agree with Mr. Swinton's opinion that this is due to overexposure, and prefers to consider the presence of the fleshy part of the hand as due to underexposure. At any rate, the difference between the Röntgen photograph of the human hand and the photographs obtained by other experimentalists, including the writer, seems to deserve further investigation. A fluorescent screen placed in front of the sensitive plate for the purpose of

Fig. 1. Leather case containing eye-glasses. Cigar case of aluminium $\frac{1}{16}$ inch thick, containing scissors, knife, etc. Exposure 1 hour (M. I. PUPIN).

Fig. 2. Fingers taken with exposure of 20 minutes (E. B. FROST).

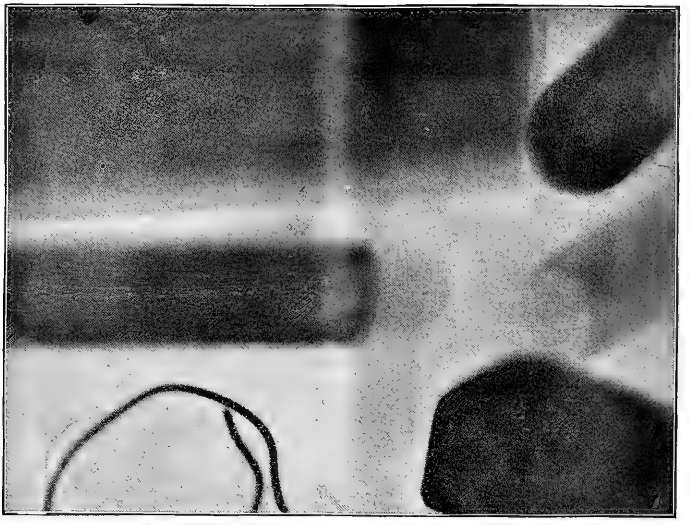

Fig. 1. The varying transparencies of a number of substances for the X-rays. At the top is a book; to its right a 'rubber' cork about 2 cm. high; just below that a 'cork' cork of equal thickness, but of far greater transparency; in the right lower corner is a crystal of Iceland spar, 1 cm. thick; in the left lower corner a loop of aluminium wire enclosing little Canada balsam (shows faintly); between the loop of wire and the spar may be very faintly seen a very thin piece of mica; above this is a hard rubber tube containing water with cork stopper; the superior transparency of cork to that of water is well shown where the cork is pressed into the rubber tube. (E. B. FROST.)

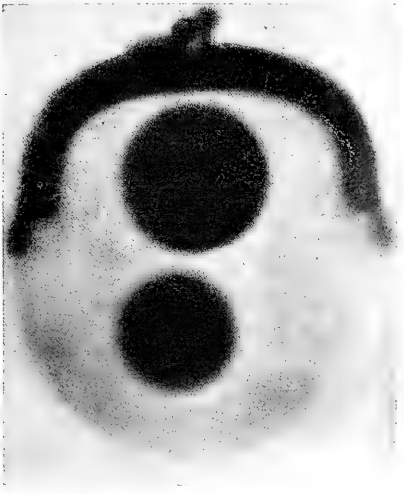

Fig 2. Coins in leather purse (A. W. GOODSPEED).

Fig. 3. Pins in cushion (A. W. GOODSPEED).

shortening the time of exposure gave encouraging results. A shortening of the time of exposure and the simplification of the apparatus employed is very desirable in the practical application of this wonderful discovery. The prospects are that both will soon be reached. It should be mentioned in this connection that a Whimshurst or a Holtz machine can very well be employed in place of the somewhat complicated apparatus employed so far. These machines should be used to charge a small Leyden jar and discharge it between small spheres which are at a suitable distance from each other. The tinfoil coatings of the vacuum tube should then be connected suitably to the coatings of the jar. This arrangement is much simpler than the one usually employed and will in all probability give just as good results—perhaps even better, because a disruptive character of the discharges seems to improve the results. This method, however, is offered as a suggestion only, since the writer could not procure a statical machine in time to convince himself of the actual value of the suggested arrangement. The practical applicability of this method of photography to surgery seems certain. M. I. PUPIN.

COLUMBIA COLLEGE, February 8, 1896.

EXPERIMENTS ON THE X-RAYS.

EXPERIMENTS with Röntgen's newly detected X-rays have been carried on during the past few days in the Dartmouth physical laboratory by Prof. C. F. Emerson and the writer, and some of the preliminary results already obtained may be worth recording.

Of four Crookes tubes first tried, but one emitted rays which (with the exposure given) made a visible impression upon a photographic plate protected from the ordinary luminous rays. This tube is 4.7 cm. in diameter and is cylindrical for a length of 16 cm., then tapering to a point. The platinum electrodes are on opposite sides of the cylindrical surface and are about 5 cm. apart. A phosphorescent plate is interposed obliquely between the electrodes. In action the phosphorescent surface is bombarded by the discharge from the negative pole. We have thus far usually excited the tube by a current from an efficient induction coil, but a Holtz machine has served about equally well.

The first successful experiment gave, after 12 minutes of exposure, a picture of a knife and scissors hung on the side (1 cm. thick) of a whitewood box, within which the photographic plate had been placed.

Subsequently, the Crookes tube was supported horizontally, and the plate-holder could then be laid upon the table and any object interposed that was desired. No camera was employed, and the slide of the plate holder was not drawn, so that no exposure to the ordinary luminous rays could occur.

A coin and key concealed between two boards of total thickness, 24 mm., were shown after an exposure of 11 minutes, the tube being 15 cm. above the plate. The power of transmitting the X-rays has been tested for a number of substances. Silver and gold seem to be the most opaque of the metals yet tried, although aluminium transmits poorly. Glass is more opaque than brass, and less so than hard rubber. Cork transmits better than any other substance examined. (See Plate 4, Fig. 1.)

An attempt to refract the rays by a carbon disulphide prism was unsuccessful, and they seemed to pass through a pair of crossed tourmalines without difficulty. No effect except that of the usual metallic obstruction was noted when the wire conveying the primary current was passed over the plate, or when the alternate current of the house circuit was sent through a loop of insulated wire resting on the plate holder.

With the tube 9 cm. above the plate an exposure of 15 minutes clearly brought out the bones of a hand laid upon the plate holder, and subsequent plates have revealed the bones of the hand and arm with startling distinctness. (See Plate 3, Fig. 2.)

It was possible yesterday to test the method upon a broken arm. After an exposure of 20 minutes the plate on development showed the fracture in the ulna very distinctly. Comment upon the numerous applications of the new method in the sciences and arts would be superfluous.

EDWIN B. FROST.

HANOVER, N. H., February 4, 1896.

EXPERIMENTS ON THE RÖNTGEN X-RAYS.

DURING the past week experiments have been in progress in the physical laboratory of the University of Pennsylvania on the Röntgen phenomena. The apparatus has been gradually simplified till now only a single induction coil about 12 inches long and $4\frac{1}{2}$ inches in diameter is used. The resistance of the primary is about 0.3 of an ohm, and that of the secondary about 3,200 ohms. The current for the primary is supplied by eight or ten storage cells connected two in multiple arc. The Crookes tube is a pear-shaped one about 10 inches long and $4\frac{1}{2}$ inches in diameter at the larger end. The exposure has been inconveniently long, an hour or more giving the best results.

Impressions of several surgical cases, including deformed fingers, fractures, etc., have been successfully produced. The results seem to be best where the tube is about 5 inches from the sensitive plate, with its longer axis vertical and the cathode at the top. A card with a broad line of white lead paint upon it was used, showing the card transparent and the paint opaque.

Special experiments made by Dr. H. C. Richards indicate that amethyst, quartz, calc spar, mica and tourmaline are quite opaque. In one of the experiments a $\frac{3}{8}$-inch aperture in a copper screen was placed $2\frac{1}{2}$ inches below the tube. The sensitive was $3\frac{1}{2}$ inches below the aperture. The result showed that the rays in passing through the opening were considerably diffused. Experiments have been arranged to examine the possible deviation of the rays in passing through a wooden prism. The results as yet are not conclusive. The pictures accompanying this article (see Plate 4) are some of a number taken on February 5th and 6th. One shows a thick leather pocket purse containing a couple of coins. Upon the same plate were placed a slip of thin glass and a bit of aluminium tube. As is seen, the glass and aluminium seem equally opaque. Another of the cuts shows the outlines of a pocket pincase taken by Dr. R. R. Tatnall. Every pin shows clearly in its place. Some flowers painted upon one of the surfaces are quite visible in the negative.

In our experiments the sensitive plates have been enclosed light-tight in an ordinary plate holder and placed horizontally upon the table beneath the tube. Upon the slide of the plate holder were placed the articles to be tested.

The wide field for the development and the application of the new science will become apparent to everyone. As has already been suggested, it may prove to be an efficient mode of examination for the surgeon. It may also be used to judge the genuine from the false as in the detection of a spurious diamond or other gem from the real.

As the X-rays are not light rays, but probably are some form of radiant energy, the writer has suggested the term *radiography* instead of photography for the new process.

The comments of several scientists that the form of wave motion transmitting the energy concerned in the Röntgen phenomena is longitudinal and not transverse, have especial interest. It is shown in a recent article by G. Jaumann, in Wiedemann's Annalen for January, that by a small modification in Maxwell's equations to satisfy the conditions of high rarefaction, which is met with in a Crookes tube, longitudinal ether waves are possible, which would possess many of the properties of the so-called cathode rays.

ARTHUR W. GOODSPEED.

UNIVERSITY OF PENNSYLVANIA, Feb. 8.

SCIENTIFIC NOTES AND NEWS.

GENERAL.

AN admirable portrait of the astronomer Schiaparelli forms the frontispiece to *Minerva* for 1896.

DR. S. P. LANGLEY has been elected one of the Foreign Members of the Royal Society of London. There are now six from the United States, Alexander Agassiz, B. A. Gould, S. P. Langley, Simon Newcomb, H. A. Newton and H. A. Rowland.

NEW honors are being bestowed upon the discoverers of argon. First came the Barnard gold medal of Columbia College, then the $10,000 Hodgkins prize, then the prize of 50,000 francs from the French Institute and now it is announced that Lord Rayleigh and Professor Ramsay have been made Knights of the Legion of Honor, by order of the French Government.

MR. W. L. SCLATER, son of the veteran secretary of the Zoölogical Society of London, has been appointed curator of the South African Museum at Capetown. Mr. Sclater was for some time deputy superintendent of the Indian Museum at Calcutta, and has more recently been assistant master at Eton. Mr. Sclater is a well trained zoölogist. His predecessor at Capetown, Mr. Rowland Friman, was a botanist.

MR. ROBERT RIDGWAY, of the National Museum, has gone to Southern Florida to study the spring bird migrations, during February and March. His son, Audubon Ridgway, a promising young ornithologist, is his companion.

MR. FRANK HAMILTON CUSHING, of the Smithsonian Institution, is still engaged in the investigation of the ancient lake dwellings of southern Florida, where he has been since December.

THE aquarium, which was so attractive a feature in the display of the United States Fish Commission at the Atlanta Exposition, has been transferred to the custody of the Smithsonian Institution, and will be installed in the National Zoölogical Park in Washington.

THE delay of President Cleveland in appointing a Commissioner of Fisheries to succeed the late Colonel Marshall MacDonald is quite unaccountable. The requirements of the law as to the qualifications for this office are so explicit that there ought to be no difficulty in making a choice. There are few men in the country who possess 'proved scientific and practical knowledge of the fishes of the coast.' The position was created for the late Prof. Baird, who created the organization, and brought it to a high state of efficiency. It would seem a matter of necessity that his successor should be a naturalist and one who has had experience in the study of fishes and the fisheries.

THE government of Greece has granted to the American School of Archæology, at Athens, the privilege of making excavations on the site of ancient Corinth.

THE appointment of Dr. John S. Billings to be chief librarian of the consolidated libraries of New York City is a most excellent one—though it is to be regretted that his work in sanitary science should be interfered with. His admirable abilities as an administrator will have full exercise in this new position, and there can be little doubt that he will be able to organize some new advances in bibliography as well. Dr. G. E. Wise, of the Newberry Library, Chicago, in a recent article in the *Library Journal*, gives an appreciative survey of his *Index Catalogue of the Library of the Surgeon Generals Office*—the extent and importance of which is just beginning to be appreciated outside of the medical profession.

ONE of the most extensive zoölogical works of modern times will be *Das Tierreich* projected by the Zoölogical Society of Berlin, to be edited by Professor F. E. Schulze. It is to contain descriptions of all the known species of animals, prepared upon a uniform plan.

THE pictures of living walruses, in *The Cosmopolitan* for February, are from photographs taken by Prof. L. L. Dyche of the University of Kansas, and are exceedingly interesting and instructive. They illustrate an article by Prof. Dyche, who accompanied Lieut. Peary to the arctic regions.

Le mouvement scientifique aux Etats-Unis is the title of an elaborate paper by M. Jules Violle, of the École Normale Superieure in Paris, which has recently appeared in the *Revue générale des sciences pures et appliquées*, and in the *Annales du Conservatoire des Arts et Metiers*. M. Violle, who came over in the Exposition summer, writes very appreciatively of our astronomers, physicists and inventors, and their work; and endeavors to impress upon France that it has much to learn from the United States. "America," he writes, "has already too many advantages over us. Our most important interests demand that we should struggle to preserve the advantages which we still possess over America. High intellectual culture is not a matter of luxury or of national pride. A mere glance at the other nations of the world demonstrates that not only the prosperity of a country but its very future depends upon scientific progress, at once glorious and profitable to every citizen." M. Violle's article is elaborately illustrated, but the pictures are somewhat incongruous with the text, exhibiting chiefly public buildings and scenes at the World's Fair.

THE same number of the *Annales du Conservatoire*, has other important articles on the Chicago Exposition—one upon its general features by Emile Levasseur, member of the Institute, one on the mechanical display by M. Gustave Richard, and one upon Agriculture in America by M. Maximilien Ringelman, of the National Agricultural School at Grignon, who declares that notwithstanding certain remarkable features, our agriculture is on the whole in a very backward and primitive condition. These articles together fill two hundred pages and have numerous illustrations.

PROGRESS is being made in the endowment of a fellowship of anatomy in the Wistar Institute of the University of Pennsylvania in honor of Joseph Leidy. Of the $30,000 required, $7,000 has now been subscribed. The committee of the alumni and former students of Leidy's consists of Wm. C. Posey, Chairman; J. Howe Adams, Secretary and Treasurer; Joseph P. Tunis, Joseph Leidy, Jr., and C. H. Frazier; and there is an Advisory Committee consisting of C. C. Harrison, S. Weir Mitchell, J. M. Da Costa, Geo. A. Piersol and Isaac J. Wistar. The money so far subscribed has come chiefly from Philadelphia, but the endowment should be national and international. Subscriptions may be sent to the Treasurer or to any member of the committees.

THE following monographs of the U. S. Geological Survey are in press and will shortly be issued:

XXV. *The Glacial Lake Agassiz*, by Warren Upham. 1895. 4°. xxiv, 658 pp. 38 pl.

XXVI. *Flora of the Amboy Clays*, by John Strong Newberry; a posthumous work, edited by Arthur Hollick. 1895. 4°. 260 pp. 58 pl.

The following monographs are in preparation:

The Geology of Franklin, Hampshire and Hampden Counties, Massachusetts, by Benjamin Kendall Emerson.

The Glacial Gravels of Maine and their Associated Deposits, by George H. Stone.

Geology of the Denver Basin, Colorado, by S. F. Emmons, Whitman Cross and Geo. H. Eldridge.

Sauropoda, by O. C. Marsh.

Stegosauria, by O. C. Marsh.

Brontotheridæ, by O. C. Marsh.

Report on Silver Cliff and Ten-Mile Mining Districts, Colorado, by S. F. Emmons.

Flora of the Laramie and Allied Formations, by Frank Hall Knowlton.

A SPECIAL meeting of the Biological Section of the New York Academy of Sciences was held on January 31st to discuss the origin of instinct with reference to the inheritance of acquired character. The meeting was called in honor of Principal C. Lloyd Morgan, of Bristol, who opened the discussion. He described his own interesting experiments with chicks and ducklings, and held that these and other evidence tend to show that instincts are not perfected under the guidance of intelligence and then inherited. A chick will peck instinctively at food, but must be taught to drink. Chicks have learned to drink for countless generations, but the acquired action has not become instinctive. The discussion was continued by Profs. Baldwin, Cattell, Osborn, Hyslop and others, and was closed by Prof. Morgan.

THE Fisheries, Game and Forest Commission of the State of New York, in its annual report, recommends that power be conferred upon the Commissioners to close streams or other bodies of water in the State for a term of years, not to exceed five, when in their judgment it is necessary to resort to such procedure to enable fish planted by the commission to obtain suitable size, before fishing of any kind is permitted. It is stated that salmon planted in the Hudson River would do well if it were not for dams and nets. The Commissioners recommend as a public necessity that two bodies of water in the Adirondack region, to be selected by the Commission, be set aside by law and used as stock waters to supply eggs of lake trout and other fish for the public waters of the State. They also recommend that forest lands in the Adirondack and Catskill region be purchased, until the entire area be included in the forest preserve.

THE Proceedings of the Chemical Society (London) issued on January 14th contain an abstract of a paper by Prof. Dewar, on the liquefication of air and research at low temperatures. The author reviewed the forms of apparatus that had been used in low temperature research, pointing out that the best and most economical plant for the production of liquid air or oxygen was one based on the general plan of the apparatus used by Pictet in his celebrated experiments on the liquefaction of oxygen in the year 1878. He described his own experiments, and stated that Prof. Olzewsky's claim to priority was fantastic. In the discussion that followed Lord Playfair and Dr. Armstrong deprecated the attacks that had been made on Prof. Dewar. Mr. Blount described the Linde process for liquefying air. Trials of the process had been made on a considerable scale, and there appeared to be no difficulty in liquefying air cheaply and in quantity. At the close of the exercises Prof. Dewar said that the late Prof. Wroblewski, as early as the year 1884, predicted that liquid air would be the refrigerating agent of the future; his prophecy seems about to be realized.

WE learn from *Nature* that at their scientific meeting on March 3d the Zoölogical Society of London propose to discuss the much-vexed question of zoölogical nomenclature. This subject will be introduced by Mr. Slater, the Secretary of the Society, who will read a paper on the 'Rules for naming Animals,' lately adopted by the German Zoölogical Society, and point out the divergences between them and what is called the Stricklandian Code of Nomenclature, recognized by the British Association, and usually followed in Great Britain.

THE Agricultural Society of Austria has concluded arrangements for holding an international agricultural machinery fair in Vienna, which is to be opened on March 9th, and will last for six days.

PROF. D. G. BRINTON began on February 7th a course of eight lectures on the 'Scientific Study of Man,' to be given on successive Fridays at the Academy of Natural Sciences. The lectures are as follows:

1, 'The Universe and Man from the Standpoint of Science;' 2, 'Man's Position in the Chain of Animal Life;' 3, 'The Origin of Man;' 4, 'The Races or Varieties of Man;' 5, 'The Geographic Distribution of Man;' 6, 'Man as a Wild and as a Domesticated Animal;' 7, 'The Metaphysical in Man;' 8, 'The Man of the Present and the Future.'

AT the annual meeting of the American Forestry Association in Washington the membership was reported to be 632, and it was announced that the Association would be incorporated in the District of Columbia. The establishment of a monthly or bi-monthly publication, as the official organ of the Association, was recommended, and a plan was submitted for the affiliation of State Forestry Associations with the National Association.

M. JULES REISET, the eminent chemist and agriculturist, member of the Paris Academy of Sciences, died at Paris on February 5th, aged 78 years.

RESOLUTIONS have been adopted by the New Mexico Agricultural Experiment Station to the effect that great injury has already been done to the agricultural and horticultural interests of the Southern States by the introduction of injurious insects, and that to prevent such introduction horticultural quarantine officers should be stationed at various Southern ports, and that in addition an agent of the Department of Agriculture should be sent to study the injurious insects in Mexico, Central America and the West Indies.

PROF. S. W. Holman, of the Massachusetts Institute of Technology contributes to the December number of *The Philosophical Magazine* an article on galvanometer design in which he concludes that it is practically useless to wind turns within a distance of about one-quarter of the needle-length of the coil centre, and that to increase sensitiveness the needle must be made as short as is consistent with torsion of suspension. Those who describe sensitive galvanometers, and especially instrument makers in cataloguing are urged to present the data.

$d =$ deflexion in mm. with scale at 1 metre from galvanometer.

$c =$ current in amperes producing that deflection.

$g =$ the galvanometer resistance as connected up when d is observed.

$t =$ the time of single swing of the needle when c is measured.

THE Board of Health of New York City has passed a resolution providing that all dealers in milk must secure a license from the Board, and licenses will only be granted to those whose dairies have been properly inspected.

WE have received the first number of *The Technical Journal*, a bi-monthly publication adopted as the official organ of the Alumni Association of the Hebrew Technical Institute. Mr. Max Loewenthal, 248 East 78th St., is the editor and publisher.

The British Medical Journal states that inoculation of the virus of small-pox was practiced in Russia in very early times, the system having probably been introduced into the Caucasus from Greece or Turkey, the Tcherkesses adopting the habit of protecting their women from the disfigurements of natural small-pox. The method used was pricking in the virus elsewhere than on the arm. In China, on the other hand, the practice was, and still is, to some degree at least, to insert moist small-pox crusts in the nostril, even to blowing the virus up the nostril. Queen Catherine of Russia was inoculated in 1768, and very many followed her example, especially those near the Court; and as early as 1772 government facilities for securing inoculation were given, free operations being inaugurated in St. Petersburg, Kazan, and even Irkutsk, in Siberia.

THE investigations carried on by the geological department in the University of Wisconsin during the autumn quarter were as follows: By C. R. Van Hise: A final revision of Principles of pre-Cambrian North American Geology, a manuscript of about 500 pages of typewritten material, to appear in the 16th Annual Report of the Director of the U. S. Geological Survey; a final revision of a report upon the Marquette iron-bearing district of Michigan, about 1,000 pages of typewritten manuscript and 40 maps, to be published as a monograph with accompanying atlas by the U. S. Geological Survey. By Wm. H. Hobbs: A study of material collected in connection with an investigation of the structural geology of portions of Litchfield county, Conn., and Berkshire county, Mass., to be published in a report of the U. S. Geological Survey. With C. K. Leith, a study of ancient volcanic rocks from areas in the Fox River valley. By J. Morgan Clements: Continuation of an investigation on the pre-Cambrian volcanics of the Michigamme district. By S. Weidman and E. R. Buckley: A study of the geology of the vicinity of Wausau, Wis.

UNIVERSITY AND EDUCATIONAL NEWS.

ACCORDING to the fifth edition of *Minerva* the attendance of students at the beginning of last year at the thirty largest universities in the world was as follows:

1. Berlin	8,652	12. Leipzig	2,957
2. Vienna	6,714	13. Edinburgh	5,924
3. Madrid	5,829	14. Cambridge	2,893
4. Naples	5,040	15. Prag	2,859
5. Moscow	4,118	16. St. Petersburg	2,804
6. Budapest	3,892	17. Michigan	2,772
7. Munich	3,561	18. Kijew	2,417
8. Athens	3,331	19. Pennsylvania	2,400
9. Harvard	3,290	20. Turin	2,355
10. Oxford	3,256	21. Yale	2,350
11. Manchester	3,000	22. Minnesota	2,171

23. Glasgow	2,080	27. Columbia	1,816
24. Rome	1,916	28. California	1,731
25. Barcelona	1,887	29. Cornell	1,686
26. Helsingfors	1,861	30. Halle	1,666

The number of students in the Paris faculties was 11,010. Auditors are included in the number of students, which detracts from the value of the statistics. Thus there were 4,963 auditors at Naples, and only 77 matriculated students. At Berlin there were 4,807 auditors, but the number given above does not include students (2,632) in the Technical School, those (780) in the Agricultural School, nor those (398) in the Veterinary School. The order of the American universities and colleges having more than 1,000 students is: Harvard, Michigan, Pennsylvania, Yale, Minnesota, Columbia, California, Cornell, Chicago, Wisconsin, Nebraska, New York, Toronto, Boston, Wesleyan, Princeton, Stanford, Montreal.

THE south division of Hope College, at Brown University, was badly damaged by fire on the 4th inst. The total loss to the University, and to the students who occupied the building as a dormitory, was about six thousand dollars.

ON February 3d the Trustees of Columbia College adopted the following resolution: "That in all official publications hereafter issued by or under authority of the Trustees, all the departments of instruction and research maintained and managed by this corporation may, for convenience, be designated collectively as 'Columbia University,' and the School of Arts, as the same is now known and described, may hereafter be designated as 'Columbia College,' or 'The College.'" They also resolved that the new site of the University should be dedicated on May 2d, at which time the corner stone of three of the new buildings will be laid. Ex-Mayor Hewitt, class of '42, has been invited to deliver the oration.

Nature states that the Council of the Royal Geographical Society offer in the University of Cambridge for the present academical year a Studentship of £100, to be used in the geographical investigation (physical or historical) of some district approved by the Council. Candidates must be members of the University of not more than eight years' standing from matriculation, who have attended the courses of lectures given in Cambridge by the University lecturer in geography. Applications should be addressed to the Vice-Chancellor not later than March 13, 1896.

DISCUSSION AND CORRESPONDENCE.

THE DECLINATION SYSTEMS OF BOSS AND AUWERS.

THE recent paper by Dr. Chandler on the declination systems of Boss and Auwers has been followed by another paper on the same subject by no less an authority than Prof. Newcomb. This paper appears in the *Astronomical Journal* of February 3d. Prof. Newcomb comes to the same conclusion as Dr. Chandler, namely, that the system of Auwers has now become so erroneous as to be quite unfitted for use as a standard. It is of course well known that Auwers' system is in need of revision; indeed we believe that such a revision is now in progress under the direction of the author himself. We cannot see, however, that Prof. Newcomb's paper throws any new light on the matter. As we pointed out in our notice of Dr. Chandler's paper, it is at present a matter of individual opinion how much weight should be attached to Bradley's observations. The vast majority of astronomers think that they are entitled to some weight in the formation of a system. Yet they receive no weight whatever in Boss' system which Dr. Chandler and Prof. Newcomb think should now be employed in place of Auwers'. Prof. Boss has not made public his opinion as to the weight due to Bradley's observations, so far as we know. That he attached no weight to Bessel's reduction of Bradley appears of course from his work on standard declinations, but whether he would do the same with Auwers' reduction of Bradley we do not know at present.

Coming now to the actual arguments advanced by Prof. Newcomb, we will first state very briefly what they are. Passing over those which appear to be of minor importance, we would call special attention to the results presented in Section III. of Prof. Newcomb's paper. Here are tabulated the corrections to Boss' declinations of twenty stars, divided into two groups of ten each, and each covering about two degrees of declination. The corrections are given for the epoch 1755, when they depend on Auwers-Bradley; 1875, when they depend on Pulkowa; 1880, depending on Greenwich; 1885, on Pulkowa; and finally, 1890, depending on Greenwich. The corresponding corrections for 1847, which is the mean epoch of Boss' system, are taken as zero. From the fact that these corrections to Boss do not vary uniformly with the time, Prof. Newcomb draws the conclusion that Bradley's observations must be inconsistent with the truth, which seems to imply that they are to be accorded no weight in forming a normal system. Yet we may well ask whether the numbers given by Prof. Newcomb are accurate enough to furnish any information of reliability. In his zone A the correction to Boss for 1755 is $-2''.23$. But the ten numbers of which this is the mean have a range of no less than $4''.00$. So we can hardly escape the conviction that the whole conclusion may be vitiated by a large error in a particular star. That this has occurred is not altogether impossible. For zone B the corresponding mean is $0''.27$, with a range of $2''.30$ in the ten numbers whose mean has been taken. We cannot regard conclusions based upon evidence so discordant as final. It is to be noted also that only one of the twenty stars used by Prof. Newcomb is to be found in Boss' mean system. The other nineteen stars are among those taken by Prof. Boss from the catalogues which were not used in forming the mean system, but which were reduced to the mean system by the aid of systematic corrections. Indeed in all researches with Boss' system we are met at every step by the insuperable difficulty that his original mean system does not contain stars enough to get rid of casual errors in individual stars. While therefore we agree with Prof. Newcomb's final conclusion that the system of Auwers cannot be regarded as definitive, and that it requires revision, we wish to point out that the same is true of the Boss system. And finally we wish to repeat our former statement that it is not at present practically possible to employ the Boss system, because the reductions to that system for the recent accurate catalogues have not been published. This has been done with care for the Auwers system, and until it has been done for the Boss system astronomers wishing to deduce for any purpose the most accurate declination of a star from all the catalogues will have to use the Auwers system.

H. J.

THE AGE OF THE PHILADELPHIA BRICK CLAY.

In Prof. Salisbury's last excellent report on the Surface Geology of New Jersey some of the most important points are likely to be overlooked by reason of the different names applied to the same formation by successive investigators. Fully to appreciate the light which Prof. Salisbury's investigations shed upon some of the points recently under discussion, it is necessary, after the manner of the mathematicians, to substitute in one equation its equivalent in another.

What was formerly referred to as the 'Philadelphia Brick Clay' was later correlated with the 'Columbia.' This, however, is now properly described by Prof. Salisbury in the New Jersey report (from its place of greatest development in that State), under the name of 'Jamesburg,' of which he says there can be no doubt that it corresponds to the Columbia. This deposit as developed on the Pennsylvania side of the Delaware River, from Philadelphia to Trenton, was very carefully studied fifteen years ago by the late Prof. Carvill Lewis, his views regarding it being embodied in various papers published about that time and finally in the last chapter of Abbott's 'Primitive Industry' (pp. 524–527), published in 1881. His conclusions were "that this clay may be assigned to a period when the land stood 150 feet or more below its present level, and when the cold waters from the melting glacier bore ice rafts which dropped their boulders."

After going over much of this field with Prof. Lewis, I adopted these views and incorporated them into my various references to the subject. (See especially Proc. of the Boston Soc. of Nat. Hist., Jan. 19, 1881, p. 141; Ice Age in North America, p. 523, and later in Am. Jour. Sci., March, 1894, pp. 180, 181.) It is gratifying to see that Prof. Salisbury's studies upon the New Jersey side of the river lead him to substantially the same conclusions. First, in opposition to Mr. Upham, he now holds that (p. 126) "it seems certain that the formation (Jamesburg) was produced during the submergence of the area which it covers;" secondly (p. 128), that "the period of submergence must have been short;" and thirdly (p. 129), that "the amount of erosion accomplished since the deposition of the Jamesburg is slight. This is shown * * * by the undissected flats of this material, even where in close association with considerable streams. * * * Either the formation is very recent, or conditions since its development have been most unfavorable for erosion * * *. The small amount of erosion which it has suffered seems hardly consistent with its correlation with the earliest glacial epoch."

In order to understand the distinct advance here made, one has but to refer to Prof. Chamberlin's article in the *American Journal of Science*, for March, 1893, pp. 191, 192, where he enumerates among the features which he thinks 'may be accepted as demonstrative,' first, that "an older fluviatile deposit (the Philadelphia Brick Clay) is to be associated in age with the old glacial drift," and "that after the formation of this older river deposit, which took place at a low altitude and a low gradient, there was an epoch of elevation and erosion, during which the Delaware cut its channel down to the depth of 200 or 300 feet below the upper old terrace." It would seem now that this interpretation must be abandoned for the Delaware, as a similar interpretation had to be abandoned for the gravel terraces near the junction of the Conewango and the Allegheny Rivers two years ago. Mr. Salisbury is undoubtedly correct in believing that these high level gravel and clay deposits in the Delaware Valley, in the vicinity of Trenton, are of comparatively recent deposition. They are not older, but younger, than the erosion of the rock channel of the Delaware.

I may say in conclusion, also, that the investigations of Prof. E. H. Williams, in the Lehigh Valley, which have been too little noticed, seem positively to show that the river channels of that whole region had been worn to nearly their present depth of rock bottom before the earliest period of glaciation. I trust that renewed attention will be attracted to this difficult problem concerning which so many facts have now been accumulated.

G. FREDERICK WRIGHT.

OBERLIN, O., January 29, 1896.

ANCIENT MEXICAN FEATHER WORK AT THE COLUMBIAN HISTORICAL EXPOSITION AT MADRID, 1892.

TO THE EDITOR OF SCIENCE: Under the above title a contribution of mine has appeared in the recently issued Report of the U. S. Commission on the Madrid Exposition, Government Printing Office, Washington, 1895. Owing to the fact that the proofs were not sent to me for revision, my paper contains several typographical errors, three of which particularly demand correction. It being too late to rectify these errors by any other means, I have adopted the present method of doing so, with the hope and earnest request that possessors of copies of the report will duly note them therein, in order to prevent future misunderstandings. On page 332 read that I identified the shield 'of Phillip II.' at the Royal Armory, Madrid, as being of Hispano-Mexican workmanship, in 'October, 1892,' instead of '1893,' as printed.

On page 335 read the 'tiny,' instead of the *wing* feathers * * * that grow on the heads and breasts of tropical humming birds.

On page 337 read Mr. Phillip Becker instead of 'Bectier(?)' I need scarcely state that, in my original text, the name of my late, highly esteemed friend, is correctly given and is not followed by an interrogation point.

Thanking you, in advance, for kindly affording me the opportunity to do myself justice.

Yours truly,

ZELIA NUTTALL.

JANUARY 14, 1896.

SCIENTIFIC LITERATURE.

NEW DATA ON SPIRULA.

Zoölogy of the Voyage of H. M. S. Challenger: Part I., XXXIII. Report on Spirula. By T. H. HUXLEY and P. PELSENEER. VIII., 32 and 12 pp. 4°, and six plates. 1895.

The eighty-third and last part of the zoölogical series of reports on the scientific results of the Challenger expedition could not be issued in one of the zoölogical volumes on account of delays in its preparation. These delays were intimately associated with the failing health of Prof. Huxley, who after making a splendid series of anatomical drawings, illustrating nearly every detail of the gross anatomy, felt himself unable to supply the text. He therefore placed his notes and drawings at the disposition of Dr. Pelseneer who has furnished a description of them, together with some additional details drawn from his examination of two other specimens submitted to him by Prof. Giard.

It is probable that there were reasons why the work was not made more complete which do not appear in the preface, and in this way the absence of histological details may be accounted for. As regards the gross anatomy there is, doubtless, little left for future anatomists now that Huxley has cleared the path, and the present monograph will remain for the future the standard of reference for this genus. This being the case, the rarity of the animal being considered, it is perhaps worth while to point out wherein Dr. Pelseneer has come to too hasty and even erroneous conclusions from the data he possessed. The U. S. National Museum possesses a nearly perfect specimen of Spirula taken from the mouth of a deep-sea fish trawled in the Gulf of Mexico, and also a fragment found at Palm Beach, Florida. The possession of the former enables me to correct certain details of the monograph.

Spirula is a remarkable animal for a cuttlefish. It is short and stout, with the posterior (caudal) end blunt, truncate and furnished with what looks like a sucking disk nearly as large as the diameter of the animal's body. In the cavity of this organ is seen a central prominence of cartilaginous consistency, the homologue of the terminal cone of Belemnites or *Onychoteuthis robusta*. On each side the 'fins' or lateral expansions of the mantle occupy a dorso-ventral plane and lateral and terminal position instead of being, as in the quickly swimming forms, in the dorsal plane or parallel to it. In short, they look as if they were adapted to serve as buttresses if the animal should fasten itself to some hard object by its terminal disk, with its body in a vertical attitude, like a sea anemone.

Spirula is extremely rare in collections, though its siphunculated shell is abundant on the beaches or floating on the sea in certain regions. Nearly all the specimens which have been taken with soft parts more or less preserved are of two sorts; one has the cylindrical muscular cortical portion complete and uninjured, but the head and viscera are missing, leaving the rest buoyed up by the shell. The other sort has the viscera and terminal portions in a perfect state, but the outer layers of the cortex lacerated or removed. The National Museum specimen is of the latter kind; the epithelium, chromatophoric layer and part of the strong muscular layer below it, are scraped off and partly hang in strings scratched longitudinally from the tail end forward to the margin of the cylinder. The delicate outer layer over the posterior end is perfectly intact, as are the fins. There can be no reasonable doubt that this scraping is due to the teeth of the fish in whose mouth it was found. Both the Challenger and the Blake specimens were in this condition, and Prof. Giard's were also incomplete, though to what extent Pelseneer does not state. The aboral disk is strongly attached to the shell, and when the specimen is fresh and elastic, if the end of the finger is pressed upon the disk and withdrawn, a distinct sensation of suction is felt, though the hardening effect of the alcohol puts an end to this after a time.

Now, the only hypothesis which seems to reconcile all the facts in the case is that the aboral disk may serve as a means of attachment to hard bodies, so that the Spirula, while not unable to swim, is in general sedentary. This explains why living specimens are not taken free in the ocean. When alive, on this hypothesis, it usually adheres to hard bodies. If it relaxes its hold, through disease or weakness, it slowly rises by the gas contained in the chambers of the shell, and the viscera under this condition decay first. If forcibly pulled off from its perch by a fish, the epithelium is likely to be lacerated, something difficult to explain if the animal were taken free swimming, as the swimming cephalopods taken from fish stomachs are not lacerated in this manner when small enough to be swallowed whole. It is undoubtedly a deep-water animal.

The testimony of Rumphius is rightly rejected by Pelseneer, but we cannot agree with him that it is necessary to abandon the hypothesis above mentioned, at least until some other function is proved for the terminal disk. Pelseneer seems to think that the rostral papilla may be covered with an external shell in the living animal, but for this there is no evidence as yet, and hardly any justification.

In most specimens the peripheral cortex has two lobes covering the lateral planes of the shell and leaving a certain portion of the outside of the whorl, dorsal and ventral, in front of the terminal disk, more or less exposed. Owen describes the epithelium as extending out over these areas of shell but not entirely enclosing them. Steenstrup describes a specimen in which the shell "was distinctly covered dorsally and ventrally, where the skin grew thin above it." Upon this Pelseneer observes, "As one might expect, this last assertion is absolutely incorrect," and "there is no portion of the integument, however thin this may be, which passes over the shell, contrary to the opinion of Owen and Steenstrup."

How difficult is the rôle of infallibility, may be judged by the fact that, in the National Museum specimen of Spirula, not only do the epithelial and chromatophoric layers extend, where untorn, completely over the dorsal exposure of the shell, but the underlying outer muscular coat,* as thick and tough as parchment, does the same; while, on the ventral side, the rags of this covering torn by the fish's teeth show that here also the shell was completely covered. The solid basal coriaceous part of the integument preserves its usual form. Huxley's figures of *Spirula Peronii* (Pl. I., figs. 1–3, 5–6) indicate the same state of affairs with great clearness, and the ragged edges of the torn integument are perfectly depicted. These are, however, interpreted by Pelseneer thus: "The margins of the openings appear to be fixed, and to have thus sent short irregularly cut prolongations over the shell." It would be rash, not having seen the specimen, to assert that these 'prolongations' are simply the rags of the former covering, but it is certain that in one species of Spirula (that referred to as *S. australis* by Pelseneer) in the adult animal the shell is completely covered by the integument, as was the opinion of Steenstrup.

Adams and Reeve have figured a very young Spirula, which Owen believed to be complete, in which the terminal disk was absent and the lateral lobes cover only a small part of the last whorl of the shell. Pelseneer has figured hypothetical stages of development for Spirula showing a gradual enlargement of the lateral lobes of integument. In most specimens so far observed, portions of the shell are certainly uncovered. It is not an extreme hypothesis to suppose that in the fully adult animal the integument in most cases will wholly enclose the shell.

The shell of Spirula is enrolled with the ventral side concave, and Pelseneer observes that the "other molluscs with rolled up univalve shells present, when they have not undergone torsion, a dorsal or exogastric rolling up, *e. g.*, *Nautilus*, embryonic *Patella* and *Fissurella*."

The learned doctor forgets that *Patella* and *Fissurella* are rolled up in opposite directions, and that *Fissurella*, if prolonged into a tube and coiled as it begins, would have an 'endogastric' whorl like Spirula. *Aliquando dormitat Homerus.*

In 1878 I saw in the Godefroi Museum, since acquired by the city of Hamburg, a large series of Spirula from the South Seas. They were partly fragmentary, but I believe comprised several perfect specimens which might throw light on doubtful points. The specimen in the National Museum came from a fish trawled in 324 fathoms in the northern part of the Gulf of Mexico, between the delta of the Mississippi and Cedar Keys, Florida. The color is yellowish white, with ferruginous and dark purple dotting profusely distributed. The specimen is a female. The temperature of the water at the bottom was 46°.5 F. It had evidently just been seized by the fish, for, except the lacerated epidermis, it is in most perfect preservation.

In conclusion we may note that perhaps the most important result of Dr. Pelseneer's analysis of the characters of Spirula is its final reference to the Oigopsid group. Owen had stated facts also confirmed by the data of paleontology which should have resulted in this classification more than fifteen years ago; but there has been a singular delay in accepting it. After the full

*Corresponding to Pelseneer's first and second layers.

details, now laid before the systematist, he should not longer delay his acceptance of the reform. WM. H. DALL.

Hunting in Many Lands—The Book of the Boone and Crocket Club. Edited by THEODORE ROOSEVELT and GEORGE BIRD GRINNELL. New York, Forest and Stream Publishing Co. 1895. 8°, pp. 447, illustrated.

The Boone and Crocket Club is an organization whose principal objects are: the preservation of the large game of America, the promotion of exploration in little known lands, the record of observations on the natural history of our wild animals, and the promotion of manly sport with the rifle. It is interested also in forest preservation. Membership is limited to one hundred, and no one is eligible who has not killed 'in fair chase' at least one kind of American big game.

The Club has done much good in diffusing a healthy sentiment against illegitimate hunting and unnecessary destruction of game, and in aiding the enforcement of game laws in the various states. It has been largely instrumental also in accomplishing the passage by Congress of an act for the protection of the Yellowstone National Park; and still more recently has secured the passage by the State Legislature of an act incorporating the New York Zoölogical Society, which Society will soon establish, in the neighborhood of New York, a great Zoölogical park.

Several years ago the Boone and Crockett Club published a volume entitled 'American Big Game Hunting,' which was made up of articles by well known writers on the game of our own country. This, and Mr. Roosevelt's personal writings, particularly his 'Wilderness Hunter,' which is incomparably the best book ever written on the large mammals of America, made it desirable to select a wider field. The present volume, 'Hunting in Many Lands,' contains chapters on Hunting in East Africa, by W. A. Chanler; To the Gulf of Cortez, by George H. Gould; A Canadian Moose Hunt, by Madison Grant; A Hunting Trip in India, by the late Elliott Roosevelt; Dog Sledging in the North, by D. M. Barringer; Wolf-Hunting in Russia, by Henry T. Allen; A Bear Hunt in the Sierras, by Alden Sampson; The Ascent of Chief Mountain, by Henry L. Stimson; The Cougar, by Casper W. Whitney; Big Game of Mongolia and Tibet, by W. W. Rockhill; Hunting in the Cattle Country, by Theodore Roosevelt; Wolf Coursing, by Roger D. Williams; Game Laws, by Charles E. Whitehead; Protection of the Yellowstone Park, by George S. Anderson. It contains also an interesting account of the Yellowstone National Park Protection Act, some Head Measurements of Trophies, and the By-Laws and List of Members of the Club.

The book is well gotten up, entertainingly written, and abounds in facts of interest to the naturalist. The editors are to be congratulated in securing such a choice selection of articles, and on bringing out the book in such attractive form. C. H. M.

Guide d'océanographie pratique. J. THOULET. Paris, G. Masson & Gauthier-Villars et fils. 1895. Pp. 224.

This is a simple, brief, and satisfactory account of the kinds of observations that are required in oceanographic investigations of the lesser depths, of the methods of making the observations, and of the instruments and implements used. There are kept constantly in view, especially with reference to the subject of maritime fisheries, the practical results that flow from the development and study of the topographic forms of the bottom of the ocean, and of the various deposits of soil that are found there; of the study of currents and winds, of transparency and coloration, of the temperature, salinity, and chemical composition of the waters of the ocean; and of the relation between meteorology and oceanography.

The book is provided with reliable and useful tables for the conversion of fathoms into metres, for the comparison of the Fahrenheit, Reaumur and centigrade thermometric scales, for the determination of the humidity of the air and the tension of vapor of water, and for finding the density and salinity of sea water.

The scope of the work, which relates principally to the continental plateau or region which lies along the borders of the oceans between the coasts and the line marking the depth of 100 fathoms, is mainly to inform the general reader what oceanographic research consists of, how it is carried on, and, in general, what has been accomplished; but it will also be found useful in the hands of the observer of oceanographic data and of the student of oceanographic problems.

An important feature of the book is the biblographic list at the end.

As the operations referred to are in the main those which are carried on in the waters of lesser depth bordering the oceans, a less general title would have been more appropriate.

No inadvertence in the revision of the proofs has been detected except the manifest confusion between t and t′ and f and f′ in the explanation of the hygrometric formulæ on page 110.

G. W. LITTLEHALES.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, DECEMBER–JANUARY.

Review of the Geological Literature of the South African Republic: By S. F. EMMONS. The great and rapid development of gold mining in the Transvaal has attracted the attention of the world to this region, not otherwise of immediate interest. This article sums up the literature concerning the gold fields. The most important of these is the Witwatersrand, usually called 'the Rand,' in which Johannesburg is situated. This is in the southern part of the Republic. It is about 2,000 square miles in extent. The rocks are auriferous conglomerates of which there are several beds. On the whole the gold is distributed rather uniformly in these beds. They are crossed by basic dikes as well as quartz veins, and at the intersection of the latter the quartz is said to be peculiarly rich. As to the origin, the author quotes Smeisser as saying that the evidence points to the fact of deposit with the conglomerate 'fossil placer deposits' and also to deposit from solution subsequently. Working has progressed to a depth of nine hundred feet, but drill holes show that workable beds extend much deeper. The average gold content of this region is ten to fifteen dollars per ton. The output for 1894 was £7,800,000; that of 1895 is estimated at £8,750,000. Hatch estimates the whole product of the Transvaal at £700,000,000, a sum greater than the whole product of the United States up to date.

Igneous Intrusions in the neighborhood of the Black Hills of Dakota: By I. C. RUSSELL. This is a description of a series of hills on the northern border of the Black Hills which appear to be of a type not clearly recognized heretofore. All are due to the intrusion of igneous rock into stratified beds, but they differ from the laccolites of Gilbert in that the molten material did not spread out into a broad dome. They differ equally from the volcanic necks of Dutton, since they did not reach the surface. The name Plutonic Plug is proposed for the intruded mass. Perhaps the most impressive of these plugs is that of Mato Teepee, which has been completely uncovered and rises almost perpendicularly from its platform to a height of 625 feet. Basaltic structure is beautifully developed, the columns reaching a diameter of ten feet. How the sedimentary beds were lifted or displaced to admit of the intrusion of such a mass is not clear to the author.

The Geology of New Hampshire: By C. H. HITCHCOCK. Historical accounts of the surveys of several States have already been given in the Journal. The present article continues the series. The first survey of new Hampshire was begun in 1839 by Dr. C. T. Jackson, of Boston. This lasted three years. The second survey, under the direction of the author, was begun in 1868 and continued ten years. Great difficulties were encountered in the wildness of the region, and the fact that the study of crystalline rocks had not at that time progressed very far, and the crystalline area in the State was considerable. Much attention was paid to surface geology. Such questions as the direction of movement of the ice sheet, the diversity of the 'ice age,' terminal moraines, river terraces, etc., were carefully studied and much light was thrown upon them during the course of this survey.

North American Graptolites: By R. R. GURLEY. No general revision of the American graptolites has been attempted since Hall's work was completed, thirty years ago. This paper is an attempt at such a zoölogic and geologic revision, though its aim is mainly geologic. All the species known in American strata are discussed with reference to generic disposal and ascertained range. A complete list accompanies the paper.

T. C. Chamberlin reviews 'The Hill Caves of Yucatan,' by Henry C. Mercer, and also a paper by G. Frederick Wright, 'New Evidence of Glacial Man in Ohio.'

The evidence in question in the latter paper is a rude stone implement found in a gravel terrace near Brilliant, on the Ohio River, by Mr. Sam. Huston, a surveyor and collector, three or four years ago. The reviewer suggests that some of the natural modes of intrusion are not excluded by Mr. Huston's observations, and that it was not shown that the terrace is primary. The fact that there are terraces along the river at much higher levels gives ground to suspect that the terrace may be more or less secondary and reworked in post-glacial times. Respecting intrusion, it is pointed out that the decay of tree roots, which had deeply penetrated the porous sand and gravel, might afford the means of intrusion to the moderate depth at which the implement was found (eight feet), without any notable disturbance of the stratification.

T. Wayland Vaughan reviews at length an important paper by J. A. Merrill, 'Fossil Sponges of the Flint Nodules of the Lower Cretaceous of Texas;' and S. Weller reviews the 'Thirteenth Annual Report of the State Geologist of New York.'

THE PSYCHOLOGICAL REVIEW, JANUARY.

The new volume opens with an article by Prof. G. S. Fullerton on *Psychology and Physiology*, in which it is argued that the discussion of the nervous system in works on physiology contains more anatomy and psychology than physiology. Foster's *Text-Book of Physiology* is taken as an illustration to show how consciousness is used where physiological knowledge fails, the sensory-motor arc being described as partly physical and partly psychical. If the parallel or automaton theory be adapted by the physiologist he should aim to make his science wholly independent of psychology; if he admit a causal interaction between body and mind he should leave to psychology the investigation of the mental process. Each science has its appropriate methods, and neither should trespass on the field of the other.

Prof. Münsterberg communicates four researches from the psychological laboratory of Harvard University. Dr. W. G. Smith has investigated the place of repetition in memory. When ten 'nonsense' syllables were read, there were remembered with entire correctness after one repetition 2.2; after three repetitions, 2.5; after six, 2.8; after nine, 3.4; after twelve, 3.9. The increase with continued repetitions is perhaps less than might have been expected, but there was a considerable degree of individual variation, one observer remembering but one, and another 6.2 syllables after twelve repetitions. Miss M. W. Calkins contributes experiments on the relative significance of frequency, recency, primacy and vividness in association. A color and a numeral were shown in conjunction, and after a series had been given the colors were repeated in a changed order and the suggested numerals recorded. Frequency was the most constant condition and vividness next in importance. Mr. L. M. Solomons shows that if a white disk is placed in a weak light, and a rotating black and white disk in a stronger light, it is not possible to get the two to look alike. Mr. J. P. Hylan reports on fluctuations in the intensity of weak sensations.

There are shorter contributions by Prof. Strong on physical pain and pain nerves; by Prof. Jastrow on community of ideas of men and women; by Mrs. Franklin on the functions of the rods of the retina; by Mr. Urban on the prospective reference of mind; by Prof. Hyslop on localization in space, and by Mr. Lay on synæsthesia. Recent psychological literature is reviewed at length by Professors James, Binet, Cattell, Hibben, Angell and others.

PSYCHE, FEBRUARY.

A. Davidson describes the habits of a California wasp of the genus Odynerus, which with its parasite, bred by Dr. Davidson, are described by W. H. Ashmead. W. S. Blatchley continues his notes on the winter insects of Vigo county, Ind., the present instalment covering the Carabidæ. H. G. Dyar gives a synopsis of the larvæ of the moths or the genus Notolophus (Orgyia), with critical notes on most of the species. A. P. Morse continues his discussion of the Tryxalinæ of New England by an account of the new genus Pseudopomala, the single species of which is described in detail. J. W. Folsom describes three new species of the Thysanuran genus Papirius found in Massachusetts. Sharp's treatment of the insects in the new volume of the Cambridge Natural History is reviewed, and the proceedings of the Cambridge Entomological Club for January are added. In a supplement, containing contributions from the New Mexico Agricultural Experiment Station, new insects are described by T. D. A. Cockerell and L. O. Howard, including diagnoses of a large number of new Coccidæ by the former.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON, 84TH REGULAR MEETING, THURSDAY, DECEMBER 12, 1895.

THE President, Chas. E. Munroe, in the chair, with thirty-six members present. Messrs. H. Carrington Bolton, W. W. Skinner and F. B. Bomberger were elected to membership. Dr. W. F. Hillebrand discussed and exhibited the spectra of Argon and Helium.

Dr. H. W. Wiley read a paper on the 'Use of Acetylene Illumination in Polariscope Work with Illustrations.' He said that Acetylene, while not inferior to other forms of illumination in point of accuracy, is so intense as to permit of accurate polarization with solutions so dark in color that they cannot be polarized with lights ordinarily used for this purpose. The Acetylene light and the 'Schmidt-Haensch Triple Field Polariscope' were exhibited. This polariscope was said to be of great assistance in rapid and accurate work.

Mr. F. P. Dewey presented a comprehensive paper on 'The Early History of Electric Heating for Metallurgical Purposes.' He traced the history of the application of the current to the production of metals from heated compounds, the necessary heat being developed by the current itself. Beginning with the very early work of van Marum, published in 1795 at Haarlem, the idea was followed through the work of Sir Humphrey Davy, 1808–1808; Children, 1809–'15; Depretz, 1848–'9; Pichon, 1854; Fox, 1875; Siemens, 1879; Bradley, 1883; Cowles, 1885; Heroult, 1886, and Moissan, 1892–'5.

Dr. Marcus Benjamin contributed a 'Sketch of Professor Josiah P. Cooke,' who, from 1849 until the time of his death in 1894, was Ewing Professor of Chemistry in Harvard University. The sketch was of special interest from the fact that the statements given were taken from a manuscript sent by Prof. Cooke to Dr. Benjamin some years ago. Besides his six years' interest in the great chemical inventions of his time, *i. e.*, friction matches, daguerreotypes and gun cotton, the development of the chemical department under his guidance was fully described. The first practical instruction in chemistry to undergraduates in our American colleges was given by Prof. Cooke. A laboratory was fitted up in a cellar room of University Hall, of Cambridge, and from this grew the present magnificent equipment. Dr. Benjamin discussed Prof. Cooke's chemical work, especially that on the atomic weight of antimony, and referred also to his writings, of which 'The New Chemistry' is probably best known.

A. C. PEALE,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 254TH MEETING, JANUARY 25.

CHARLES T. SIMPSON presented a paper on *The Extra-limital Mississippi Basin Unios.*

The speaker stated that the Unione fauna of the Mississippi basin was one in which the species were finely developed, often large or solid, richly sculptured or colored. The fauna of the Atlantic region consisted of smaller, less finely developed forms. The boundary between these regions on the north and northeast is not at the Height of Land, but far to the northward. Some 40 or more species of Mississippi naiades are found extra-limital in the northern and Atlantic drainage, while probably but a single Atlantic drainage form inhabits the Mississippi Valley. He believed this distribution was caused by the fact that at the close of the Glacial Epoch the northern lakes overflowed into the Mississippi Valley, and the Mississippi basin species ascended by way of these old streams into the British possessions.

These extra-limital forms were generally smaller and thinner, less highly colored, and less strongly sculptured than when found in southern waters, and on these geographical variations a large number of species had been founded. Most of these are merely varieties of well-known Mississippi basin forms ; a few have, perhaps, developed into good species. He believed these changes had all been wrought since the close of the ice age.

Similar changes on a larger scale had apparently taken place in the closely related unione fauna of the Atlantic drainage system, which, he believed, had been for the most part derived from the fauna of the Mississippi Valley, though at an earlier date.

M. B. Waite described the *Life History of the Pear-blight Microbe, Bacillus amylovrous.* The *Bacilli* first attack the blossoms and other new growth in spring. They multiply in the nectar of the blossoms and are able to enter the tender tissues of the nectar disk without a puncture. The germs are spread with great rapidity in the orchards during blossom time by bees and other insects. New infections take place on the tips of growing twigs or on newly opened leaf buds as well as on the blossoms, and may occur at any time that new growth is pushing out.

The majority of cases of blight come to a standstill after running their course, the twigs dry up and the germs all die in a week or two of exposure to summer weather, for this *Bacillus* forms no spores and cannot withstand drying. Some of the cases of blight do not, however, come to a standstill but continue slowly through the summer. Again, late growth in autumn often results in new infections, so that the trees go into their winter condition with active germs in them. These cases keep the Bacilli alive, and the speaker had been unable to find the germs living over winter in any other way. These cases of 'hold-over' blight are the key to the pear-blight question, for by cutting them out and destroying them when the tree is in a dormant or semi-dormant condition we can exterminate the microbes and prevent or control the disease.

Pierre A. Fish spoke of *the Action of Electricity upon Nerve Cells*, stating that Hodge's experiments have shown that certain well-defined changes occur in the structure of the nerve cell as a result of the stimulation of the nerves by weak electric currents. A strong current, on the contrary, such as is used in electrocutions, seems to cause no visible change, apparently killing and fixing the protoplasm in a manner analogous to that produced by histological reagents.

He gave the results of the examination of nervous tissue from three electrocuted subjects: In No. 1 a portion of the myel was examined, particularly the motor cells, and the cytoplasm in most cases showed numerous vacuoles. In No. 2 normal cells were the rule, and vacuoles the exception in the cervical myel. A small portion of the cortex from the precentral gyre (the region nearest the electrode) showed vacuolation of the large and small pyramidal cells, either in the cell body, or in the peripheral process. In No. 3 a small portion of the cerebellum only was obtained, and after careful search vacuoles were found in two Purkinje cells.

As vacuolation of the nerve cell is often the result of disease, an examination of plenty of material and a knowledge of the previous history of the individual is essential for a solution of the question of the action of electricity.

C. Hart Merriam read by title a *Revision of the Lemming-Voles (genus Synaptomys).*

Mr. Vernon Bailey read a paper entitled *Tamarack Swamps as Boreal Islands.* He stated that the common Eastern tamarack (*Larix americana*) is generally considered a boreal tree. East of the Rocky Mountains it over-reaches the Boreal Zone, and occurs in scattered swamps throughout the transition and even in the northern part of the Upper Austral Zone. Such swamps are common in central Pennsylvania, northern Ohio, southern Michigan and northern Indiana, though the line marking the southern limit of the Boreal Zone is drawn much farther north. Within a radius of ten miles from Ann Arbor, Mich., which is in the Upper Austral Zone, are at least a dozen such swamps, ranging in size from a few acres to a mile square.

The vegetation of these swamps is composed largely of boreal species of plants, including the white birch, cassandra, andromeda, cranberries, pitcher plants, many species of northern grass, carex, herbaceous plants, mosses and a carpet of sphagnum, 5 to 8 inches thick, as porous and absorbent as a sponge. The stem and leaves of sphagnum have a peculiar porous structure, through which a constant flow of water is carried up and poured out to evaporate on the surface. Thus by constant evaporation the plant and its surrounding atmosphere are kept cold. Ice was found under the sphagnum in one of these swamps as late as May 10, although the preceding winter had been mild and the snow had all disappeared by the middle of March. A number of small shrews (*Sorex personatus*), a boreal species of a boreal genus, were taken in one of these swamps, some being caught in traps resting on ice. The star-nosed mole, another boreal mammal, also occurs in some of these swamps, and the varying hare (*Lepus americanus*) was formerly common.

Evidently these boreal species of plants and animals are retained in the Southern swamps by the low temperature produced by evaporation from the sphagnum. F. A. LUCAS, *Secretary.*

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, JANUARY 21, 1896.

On the Origin of the Copper Deposits of Keweenaw Point: By PROF. H. L. SMYTH.

After a brief review of the character and structure of the rocks of the Keweenawan Series, and the geological and geographical distribution of copper in them, the author pointed out the close genetic connection between the three forms of occurrence of copper in this district. The amygdaloid and conglomerate 'floors' in the vein mines are essentially the same except in scale, as the greater impregnated and replaced amygdaloids and conglomerates. From this consideration all would date from the time of formation of the fissures of the vein mines; this was probably the time of general tilting, and long subsequent to the formation of the lower flows and conglomerates.

Pumpelly worked out many years ago a paragenetic series among the mineral associates of the copper; this series cleaves along a chemical line. The earlier minerals, which preceded the copper, are chlorite mainly, with certain other non-alkaline hydrous silicates; the latter are alkaline, and are close contemporaries of the copper. Among them are apophyllite (a fluorine mineral), and datolite (a boron mineral). Calcite is abundant through the whole series.

The author pointed out that from the consideration of the conditions of formation of the separate flows, with their subordinate intercalated conglomerates, each after consolidation was immediately subjected to the action of meteoric waters. Afterwards, by slow subsidence, each bed would eventually sink beneath their reach. The minerals of the first division of Pumpelly's series, essentially weathering products, belong to the successive periods of exposure of individual beds. The observed progress of alteration, from top to bottom in each individual bed, accords with this view, as do also the non-alkaline alteration products.

Afterwards came the northerly and northwesterly tilting, and the formation and filling of the fissures, and the impregnation and partial replacement of the amygdaloids and conglomerates. The new minerals of this period are sharply separated from the alteration products of the first (which they often replace) by their richness in alkalis, and the presence of fluorine and boron. The two periods, therefore, are far separated in time as well as by the character of the chemical agents at work, and do not, as Pumpelly supposed, represent a continuous march of alteration.

The author then discussed the more immediate questions of origin, and concluded that neither Pumpelly's view, that the copper had been brought down from the sandstones of the upper division of the series, nor Wadsworth's, that it had come from the lava-flows themselves, was probable. On the other hand, the mineral associates of the copper, the time of formation, and, in the case of the veins, the evident arrest of the copper-bearing solutions below the relatively impervious greenstone, all pointed to a deep-seated source and to ascending solutions as the transporting agent.

As to the precipitating agent, the author could not accept the view that it was electrolytic in its nature, because the deposition was manifestly accompanied in so many cases by the chemical destruction of the cathode. It was concluded that in spite of lack of confirmation by laboratory experiment, no theory so well explained the invariable deposition of metallic copper to great depths as Pumpelly's, viz: that it was effected by the reduction of copper salts by the FeO in the universally present chlorite.

T. A. Jaggar, Jr.,
Recording Secretary.

ST. LOUIS ACADEMY OF SCIENCE.

At the meeting of February 3, of the Academy of Science of St. Louis, President Gray in the chair and twenty-two other persons present, Mr. Trelease exhibited several specimens, about three feet square, of a curious silk tapestry, taken from the ceiling of a corn storing loft in San Luis Potosi, Mexico, by Dr. Francis Eschauzier, stating that he was informed that the larger specimen had been cut from a continuous sheet over twenty yards wide and about four times as long. The specimens, of a nearly white color, and of much the appearance and feeling of a soft tanned piece of sheepskin, were shown to be composed of myriads of fine silken threads, crossing and recrossing at every conceivable angle, and so producing a seemingly homogeneous texture. Although specimens of the creatures by which they are produced had not been secured, it was stated that there was no doubt that these tapestries are the work of lepidopterous larvæ which feed upon grain, the presumption being that they are made by the larvæ of what has been called the Mediterranean Grain or Flour Moth (*Ephestia Kühniella*). The speaker briefly reviewed the history of this insect and its injuriousness in various parts of the world, and quoted from a report of Dr. Bryce, showing that in Canada, where it became established in 1889, 'a large warehouse, some 25 feet wide, 75 feet long, and four stories high, became literally alive with moths in the short course of six months.'

One name was proposed for active membership.

William Trelease,
Recording Secretary.

NEBRASKA ACADEMY OF SCIENCES.

The fifth annual meeting was held in Lincoln January 2 and 3, at which a considerable number of papers were presented.

Dr. C. E. Besssy discussed the peculiar conditions by which the Buffalo grass had developed here on the plains from the nearly related Gramma grasses; and also the origin of the present flora of Nebraska in general.

Prof. C. D. Swezey showed by a comparison of early rainfall records in Nebraska with those of recent years that there is no evidence of any progressive change of our climate either towards greater rainfall or towards droughty conditions.

Mr. H. S. Clason presented facts dealing with the primitive civilization in America as indicated by the character of the ruins left.

Prof. F. W. Card showed how much less important were the economic fungi of the West than in the East, owing to our drier climate.

Dr. H. B. Ward described some new and little known animal parasites from Nebraska.

Mr. C. J. Elmore described some fossil diatoms from the State, and Dr. E. H. Barbour gave some facts as to the occurrence of considerable deposits of these organisms, such as give promise of commercial value.

Mr. G. A. Loveland presented an analysis of wind velocity records in the State to show how many hours a day the wind may be depended on for windmill power.

Dr. E. H. Barbour made a report of progress on the peculiar fossil Dæmonelix, of which he has now obtained a series of forms from successive horizons, indicating its probable genesis and development.

Lincoln, Neb., February 4, 1896.

G. D. Swezey,
Secretary.

NEW BOOKS.

A New View of the Origin of Dalton's Atomic Theory. Henry E. Roscoe and Arthur Hardey. London and New York, Macmillan & Co. 1896. Pp. ix + 190. $1.90.

The Number Concept, Its Origin and Development. Levi Leonard Conant. New York and London, Macmillan & Co. 1896. Pp. vi + 218. $2.00.

The Spraying of Plants. E. G. Lodeman. New York and London, Macmillan & Co. 1896. Pp. xvii + 399. $1.00.

La Théorie Platonicienne des Sciences. Élie Halévy. Paris, Alcan. 1896. Pp. xl + 378.

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*HUXLEY AND HIS WORK.**

I.

THE history of scientific progress has been marked by a few periods of intellectual fermentation when great bounds have been taken forwards and a complete revolution ensued. Very few have been such, but in one the name of Huxley must be ever conspicuous. It was as a lieutenant of the organizer of that revolution that he appeared, but unquestionably without him it would have been long delayed, and it was through his brilliant powers of exposition that the peoples of the English speaking lineage soon learned to understand, to some extent, what evolution was and, learning, to accept it.

On the 4th of May, 1825, was born the infant Huxley, in due course christened Thomas Henry. "It was," Huxley himself has remarked, "a curious chance that my parents should have fixed for my usual denomination upon the name of that particular apostle with whom I have always felt most sympathy." In his physical and mental peculiarities, he was completely the 'son of his mother,' whose most distinguishing characteristic was 'rapidity of thought;' that characteristic Huxley claimed to have been passed on to him 'in full strength,' and to have often 'stood him in good stead,' and to it he was

* A memorial address given on January 14th before the Scientific Societies of Washington.

undoubtedly indebted for success in the many intellectual duels he was destined to be engaged in. His 'regular school training was of the briefest,' and he has expressed a very poor opinion of it. His early inclination was to be a mechanical engineer, but he was put to a brother-in-law to study medicine. The only part of his professional course which really interested him was physiology, which he has defined as 'the mechanical engineering of living machines.' The only instruction from which he thought he ever obtained the proper effect of education was that received from Mr. Wharton Jones, who was the lecturer on physiology at the Charing Cross School of Medicine. At Mr. Jones' suggestion, in 1845, Huxley communicated to the *Medical Gazette* (p. 1340) his first paper 'On a hitherto undescribed structure in the human hair sheath.' Two years later he contributed to the British Association for the Advancement of Science the first paper generally attributed to him—'Examination of the corpuscles of the blood of Amphioxus.' (Abstracts, p. 95.) In 1845 he passed the first M. B. examination at the London University. Soon afterwards he was admitted into the medical service of the Navy and was, after some waiting, assigned to the Rattlesnake, and for four years (1846–50) served on her during her exploration of the Australasian seas; he was, he supposed, among the last voyagers 'to whom it could be possible to meet with people who knew nothing of firearms—as [they] did on the south coast of New Guinea.'

While on board Huxley zealously prosecuted zoölogical investigations and in 1849 and 1850 sent records of observations, especially on cœlenterates, in papers which were published in the 'Philosophical Transactions' and 'Annals of Natural History.' Most important of all was a monograph on the Oceanic Hydrozoa published by the Ray Society. It is amusing to find that while in Sydney he was impressed by MacLeay and led to believe that "there is a great law hidden in the 'Circular system' if we could but get at it, perhaps in Quinarianism too,"* but sober sense doubtless soon came to the rescue and he appears to have been never otherwise touched by the strange monomania that had been epidemic in England during the previous quarter century. In 1851 he became a F. R. S. He continued in the navy three years after his return, but in 1853 resigned when ordered to sea again.

In 1853 Huxley and Tyndall became candidates for professorships in the University of Toronto, but that University preferred others for the vacant places and thus missed the opportunity of an age. In 1854 Huxley was appointed to the post of paleontologist and lecturer on natural history in the School of Mines which he held for the next thirty-one years. In the same year he became Fullerian Professor to the Royal Institution. "The first important audience [he] ever addressed was at the Royal Institution." In 1862 he served as President of the Biological Section, and in 1870 of the 'British Association for the Advancement of Science' itself, in 1869 and 1870 of the Geological and Ethnological Societies, and in 1883 to 1885 of the Royal Society. He was Inspector of Salmon Fisheries from 1881 to 1885.

In 1876 he visited the United States and delivered an address at the opening of the Johns Hopkins University.

In 1885 failing health and desire for freedom led him to retire from most of his offices and thenceforth he devoted himself chiefly to literary work rather than to scientific investigation. On the accession of Lord Salisbury to the Premiership in 1892, Huxley was made Privy Counsellor, and with it came the title of Right Honorable, by which he was later styled. In the last years of life he resided at Hodeslea, East-

*Ann. Mag. Nat. Hist. (2), VI., p. 67.

bourne, and after a long illness ('complication following influenza'*) died there on the 29th of June, 1895.

Such were the principal episodes in the life of Huxley. Many more details may be found in the numerous periodicals of the day and in some of them are depicted various phases of his character and labors. The short time that is at our disposal tonight may be most profitably and entertainingly utilized in reviewing his feats as a warrior of science and estimating the measure of influence he exercised in diverting human thought from the ruts in which it had moved for centuries and directing it into a highway where increasing light from different sides could guide the wayfarer. Although this period of warfare was at its height not farther back than the early afternoon of the present century, and some of us here assembled joined in the fray, to the younger naturalists it is an unknown past except through history, and to some of us who were of it, it is so strange as to recur to us rather as a dream than as a realized passage in actual life.

II.

Doubtless man, almost from the moment of his acquisition of those characters which distinguish him as representative of the genus Homo, had wondered and speculated as to how he came into being and how the animals assembled round him had sprung into existence. Those early concepts must have been strange indeed, but were doubtless transmitted from mother to child, only with some eccentricities lopped off with advancing intelligence. Gradually, among peoples of the Aryan stock at least, they crystallized into a doctrine that in the beginning there was chaos, that the three elements of air, water and earth were differentiated, and that animals were successively created to occupy the spaces. Such were the views of the old oriental cosmologists and such of the later Romans as epitomized in Ovid's verse. These ideas were long regnant and naturalists embodied some in their schemes, most accepting the idea that animals may have been created in pairs, but a few (such as Agassiz) urging that they must have been created in communities approximating to those still found. There were very few to dissent from these views of specific creation, and those few had little influence on the popular beliefs. But as the present century advanced, curious men delved into all the mysteries of nature; the sciences of morphology, physiology, histology, embryology, geology and zoögeography came into being, and facts were marshalled from every side that militated against the old conceptions. Even when these sciences were inchoate, or new born, sagacious men had perceived the drift of the facts and anticipated induction by the formulation of hypotheses of evolution, but the hypotheses were too crude to ensure acceptance. Meanwhile, however, the facts accumulated, and in 1859 a factor determining the course of development of species was appreciated by Darwin and Wallace, and soon applied to a wide range of facts in the former's 'Origin of Species by means of Natural Selection.'

*Lancet, July 6, p. 64, 65.

Darwin's work at once aroused great popular interest, but it was too diffuse and the intellectual pabulum it contained was too strong and indigestible for ordinary readers, and it is probable that the general acceptance of the Darwinian form of evolution would have been delayed much longer than it was had it not been for the excursions from the scientific fold into the popular arena by one having the confidence of the former and the ear of the latter, as did Huxley.

Scarcely had Darwin's work come from the press when Huxley commenced his missionary work. Almost exceptional among numerous reviews, remarkable chiefly for crudity, ignorance and arrogance, was one that appeared in the great daily organ of English opinion—*The Times*—marked by superior knowledge, acuteness of argumentation, and terse and vigorous style. This review, which attracted general attention, was acknowledged later by Huxley. Lectures and addresses before popular audiences and even to those distinctively claiming to be 'workingmen' followed, and these were published or supplemented by publication in various forms. Answers, critiques and other articles in reply came out in rapid succession, and loud clamor was made that Huxley was an infidel and a very bad man, and that he falsified and misrepresented in a most villainous manner.

A memorable occasion was the meeting of the British Association for the Advancement of Science in the year 1860, following the publication of the Origin of Species. A discussion of the subject was precipitated by the presentation of a communication by our own Draper, 'On the Intellectual Development of Europe with reference to the views of Mr. Darwin and others, that the progression of organisms is determined by law.' The Rev. Mr. Creswell and the Rev. Dr. Wilberforce, Bishop of Oxford, followed in opposition, and they were answered by Huxley. The scene has lately been redescribed by a great physiologist and friend of Huxley, who is one of the few witnesses who now remain. "The room was crowded, though it was Saturday, and the meeting was excited. The bishop had spoken; cheered loudly from time to time during his speech, he sat down amid rapturous applause, ladies waving their handkerchiefs with great enthusiasm; and in almost dead silence, broken merely by greetings which, coming only from the few who knew, seemed as nothing, Huxley, then well-nigh unknown outside the narrow circle of scientific workers, began his reply. A cheer, chiefly from a knot of young men in the audience, hearty but seeming scant through the fewness of those who gave it, and almost angrily resented by some, welcomed the first point made. Then as, slowly and measuredly at first, more quickly and with more vigor later, stroke followed stroke, the circle of cheers grew wider and yet wider, until the speaker's last words were crowned with an applause falling not far short of, indeed equalling that which had gone before, an applause hearty and genuine in its recognition that a strong man had arisen among the biologists of England."

The versatile bishop indulged in the argumentum ad hominem so very trite and familiar to us all (Who has not heard it?): he would like 'to hear from Mr. Huxley whether it was by his grandfather's or grandmother's side that he was related to an ape.'

Huxley replied and answered: "I asserted, and I repeat, that a man would have no reason to be ashamed of having an ape for a grandfather. If there were an ancestor whom I should feel shame in recalling, it would be a man, a man of restless and versatile intellect who, not content with an equivocal success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance, only to obscure them by an aimless rhetoric and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice."

The arguments adduced against evolution during those days were sometimes very comical, and the confident air of the upholder of the ancient views and the assurance with which he claimed that his position was fixed and that the burden of proof rested entirely upon the advocate of the opposite view, were very amusing. It was urged that no one had ever *seen* one species turn into another! Had any one ever *seen* any animal made? Could any one really conceive of any animal being actually made? Did an omnipotent Creator actually take the 'dust of the ground' and mould it into animal shape and then breathe into its nostrils 'the breath of life.' 'Did infinitesimal atoms flash into living tissues.' Certainly no physiologist with a competent knowledge of histology could believe in any such mode of creation! On the other hand, every one that could exercise the necessary skill could follow the evolution of an animal from an undifferentiated protoplasmic mass into a perfect animal. A clutch of eggs could be successively taken from a mother hen or a hatching oven, and day after day the actual evolution of the undifferentiated matter into derivative functional parts could be followed. That which is true of the hen is true of man, only in the latter case it is more difficult to obtain the requisite material, and greater skill to use it is requisite. Compare the embryos developing in the hen and human eggs and at first no difference except size and environment can be perceived. Compare them in successive stages, and adult animals more or less parallel to some early stages may be found still living or entombed in earlier formations of the earth in fossilized form.

It was argued that no one had ever seen one species turn into another! But is it not a matter of historical evidence that many breeds of domestic animals have actually been developed by the agency of man and propagate their kind? And how are such breeds distinguished from species except by the fact that we know their origin, and that they have come into prominence through selection by man rather than by Nature? Interbreeding is no criterion.

But it is unnecessary to go into details, and these hints are offered only because their bearings on the subject were so generally overlooked by those who opposed evolution. One opponent, so eminent as to be styled the 'Pope' of a great Protestant Church, published a work against evolution, largely based on the contention that the existence of the eye, except through direct creation, was inconceivable! Yet this very evolution of the eye from simple protoplasm could have been witnessed at any time with little trouble in the hen's egg! Is evolution through great reaches of time more inconceivable than actual evolution capable of daily observation?

Well and skillfully did Huxley meet the arguments against evolution. Even most of the old naturalists sooner or later recognized the force of the arguments for, and the weakness of those against, evolution. Those who did not in time gave up the contest with their lives. The young who later entered into the field of investigation have done so as evolutionists.

It is interesting to recall that the illustrious American (Prof. Dana) who recently departed so full of years and honors, and of whom you have heard from a former speaker (Major Powell) to-night, at length, in the full maturity of his intellect, accepted unconditionally the doctrine of evolution and dexterously applied it in his last great work.

III.

Darwin, in his Origin of Species, had refrained from direct allusion to man in connection with evolution and many casual readers were doubtless left in uncertainty as to his ideas on the subject. Naturally, the scientific man recognized that the origin of his kind from a primate stock followed, and believed that Darwin's reticence was probably due to a desire to disturb popular beliefs as little as possible. When we recall what strange views were held respecting man's origin and relations we can understand how the unlearned could easily fail to recognize that man must follow in the chain of his fellow creatures. (We preserve creature still as a reminiscence of ancient belief, but without the primitive conception attached to the word.)

Man was claimed as a being isolated from animals generally, and naturalists of acknowledged reputation, and one or two of great fame, more or less completely differentiated him from the rest of the animal kingdom and even from the animal kingdom itself.

As long as the isolation of man from the animal kingdom, or from the greater part, was based on metaphysical or psychological ideas, the naturalist perhaps had no cause of quarrel, although he might wonder why a morphologist should stray so far from the field of observation. But when naturalists confused morphological and psychological data, he had reason to protest. This confusion was effected by one of great eminence. There was no naturalist in Britain about the middle of the century who enjoyed a reputation equal to that of Richard Owen. An anatomist of preëminent skill and extraordinary industry, his merits had been appreciated by the entire world. An opinion of his had a weight accorded to no others. Consequently a new classification of the mammals, published by him in 1857, soon became popular. This classification was founded on alleged characters of the brain and on successive phases of increase in the cerebrum. Man was isolated not only as the representative of a family, but of an order and subclass.

According to Owen, "in Man the brain presents an ascensive step in development, higher and more strongly marked than that by which the preceding subclass was distinguished from the one below it. Not only do the cerebral hemispheres overlap the olfactory lobes and cerebellum, but they extend in advance of the one and further back than the other. Their posterior development is so marked that anatomists have assigned to that part the character of a third lobe; it is peculiar to the genus Homo and equally peculiar is the 'posterior horn of the lateral ventricle,' and the 'hippocampus minor,' which characterize the hind lobe of each hemisphere. The superficial grey matter of the cerebrum, through the number and depth of the convolutions, attains its maximum of extent in Man. Peculiar mental powers are associated with this highest form of brain, and their consequences wonderfully illustrate the value of the cerebral character."

The views thus expressed by Owen were reiterated on various occasions, but many anatomists dissented from them and the rumbling of a future storm was betokened. At last the stormcloud broke and Owen was overwhelmed. At a great popular assemblage at Oxford, on the occasion of the meeting of the British Association for the Advancement of Science, Owen once more urged his contention of the cerebral characteristics of man and maintained this wide difference from the apes.

Huxley immediately rose and, with that cogency of reasoning which characterized him, proceeded to divest the subject of the sophistries in which it had been enveloped. "The question," he said, "appeared to him in no way to represent the real nature of the problem under discussion. He would therefore put that problem in another way. The question was partly one of facts and partly one of reasoning. The question of fact was, What are the structural differences between man and the highest apes?—the question of reasoning, What is the systematic value of those differences? Several years ago Prof. Owen had made three distinct assertions respecting the differences which obtained between the brain of man and that of the highest apes. He asserted that three structures were 'peculiar to and characteristic' of man's brain—these being the 'posterior lobe,' the 'posterior cornu,' and the 'hippocampus minor.' In a controversy which had lasted for some years, Prof. Owen had not qualified these assertions, but had repeatedly reiterated them. He (Prof. Huxley), on the other hand, had controverted these statements; and affirmed, on the contrary, that the three structures mentioned not only exist, but are often better developed than in man, in all the higher apes. He (Prof. Huxley) now appealed to the anatomists present in the section whether the universal voice of Continental and British anatomists had not entirely borne out his statements and refuted those of Prof. Owen. Prof. Huxley discussed the relations of the foot of man with those of the apes, and showed that the same argument could be based upon them as on the brain; that argument being that the structural differences between man and the highest ape are of the same order, and only slightly different in degree from those which separate the apes one from another. In conclusion he expressed his opinion of the futility of discussions like the present. In his opinion the differences between man and the lower animals are not to be expressed by his toes or his brain, but are moral and intellectual."

The appeal to anatomists was answered on the spot. The foremost anatomists of England there present (Rolleston and Flower) successively rose and endorsed the affirmations of Huxley. Not one supported Owen and, brilliant as his attainments were, his want of candor entailed on him the loss of his eminent place, and Huxley took the vacated throne. But the contest that resulted in Owen's overthrow was of great service, for in the chief centers of civilization anatomists eagerly investigated the question at issue, and the consequence was that in a few years more material had been collected and studied than under ordinary conditions would have been done in five times the period. Unlike other battles, one in scientific warfare is almost always advantageous to the general cause, whatever it may be to a party.

IV.

The first important memoir by Huxley was written in his twenty-third year 'On the Anatomy and the Affinities of the Family of the Medusæ' (Phil. Trans., 1849, pp. 413–434, pl. 37–39), and contained the germ of a fundamental generalization. He therein laid 'particular stress upon the composition of ['the stomach'] and other organs of the Medusæ out of *two distinct membranes*, as [he says] I believe that is one of the essential peculiarities of their structure, and that a knowledge of the fact is of great importance in investigating their homologies. I will [he continues] call these two membranes as such and independently of any modification into particular organs, 'foundation membranes' (p. 414). In his summary (p. 425) he also formulates 'that a Medusa consists essentially of two membranes, inclosing a a variously-shaped cavity, inasmuch as its various organs are so composed.'

I have thus given Huxley's own words inasmuch as Prof. Haeckel has asserted that Huxley therein "directed attention to the very important point that the body of these animals is constructed of two cell-layers—of the Ectoderm and the Endoderm—and that these, physiologically and morphologically, may be compared to the two germinal layers of the higher animals" (Nature. 1874), and Prof. Kowalevsky has also claimed that Huxley "founded modern embryology by demonstrating the homology of the germinal layers of Vertebrates with the ectoderm and endoderm of Cœlenterates" (Nature, Oct. 31, 1895, p. 651).

In all candor I must confess that, important as the generalization of Huxley for the Medusae was, it was only applied by him to the Medusae, and was not *necessarily* extensible with the homologies indicated, but it was pregnant with suggestiveness and to that extent may have led to the wider generalization that followed. Let all possible credit then be assigned to it.

The classification of animals generally adopted, and in this country especially, up to at least the early years of the present half century, was based on what was called plan or type and was mainly due to Cuvier. According to this school there were four 'great fundamental divisions of the animal kingdom,' and these were 'founded upon distinct plans of structure, cast, as it were, into distinct moulds or forms.' The term generally used to designate this category was branch or subkingdom and the subkingdoms themselves were named Vertebrates, Mollusks, Articulates and Radiates. Various modifications of this system and more subkingdoms were recognized by many zoölogists, but the one specially mentioned was in very general use in the United States because favored by Agassiz, who then enjoyed a great reputation. Almost all naturalists of other countries, and many of this, recognized the distinctness, as subkingdoms or branches, of the Protozoans and Cœlenterates. But Huxley, in 1876, went still further and segregated all animals primarily under two great divisions based on their intimate structure, accepting for one the old name, Protozoa, and for the other Haeckel's name, Metazoa.

"Among those animals which are lowest in the scale of organization there is a large assemblage, which either present no differentiation of the protoplasm of the body into structural elements; or, if they possess one or more nuclei, or even exhibit distinct cells, these cells do not become metamorphosed into tissues—are not histogenetic. In all other animals, the first stage of development is the differentiation of the vitellus into division-masses, or blastomeres, which become converted into cells, and are eventually metamorphosed into the elements of the tissues. For the former the name Protozoa may be retained; the latter are coextensive with the Metazoa of Haeckel."

While not exactly original with Huxley, the recognition of these two great categories of the animal kingdom was hastened among naturalists, and found place in most of the works by men of authority that followed. That such recognition greatly facilitates morphological concepts is certain. But most of the further new features of this classification have not received the approbation of naturalists generally. And here it may be admitted that Huxley was rather a morphologist in a narrow sense, or anatomist rather than a systematist of greatly superior excellence. Unquestionably he did much excellent work in systematic zoölogy, but the direct subject of investigation was perhaps treated from too special a standpoint, and sometimes without an attempt to coördinate it with the results in other fields, or to measure by some given standard. He was indeed a great artist, but he used his powers chiefly to sketch the outlines of a picture of nature. This was done with the bold and vigorous hand of a master, but his productions were deficient in details and finish and were sometimes imperfect on account of inattention to perspective and perhaps deliberate neglect of the niceties of nomenclature. (And lest I may be misunderstood, let me here explain that by systematic zoölogy I mean the expression of *all* the facts of structure in a form to best represent the values of the differences as well as resemblances of all the constituents and parts of the entire organization, from the cells to the perfected organs and the body as a whole.) For example, he separated Amphibians from Reptiles and combined them with Fishes, and yet under the last name comprised the Leptocardians and Marsipobranchs, and to his influence is doubtless due to a large extent the persistence of English (but not American) naturalists in a combination which is elsewhere regarded as contradicted by all sound morphological doctrine.* The value of the characters distinctive of the Rhynchocephalian reptiles and their consequent significance for taxonomy and paleontology were also denied by him. Nevertheless, even his negative position was of use in that it incited investigation. The numerous memoirs on the anatomy and characteristics of various groups of animals, too, were always replete with new facts and the hints were almost always sagacious, even if not always in exactly the right direction.

I am inclined to credit mainly to his sagacity the early appreciation of the affinity of the *Neoceratodus* of Australia to the mesozoic Ceratodontids with all the far-reaching consequences that appreciation involved. It was in 1870 that the living Ceratodontid was introduced to the scientific world as *Ceratodus Forsteri*, and thus generically associated with the mesozoic fishes. How did Krefft (or Clarke) get the idea of this association of a living fish with some known only from fossil teeth referred by Agassiz to the same family as the Cestraciont sharks? In 1861 Huxley published a 'Preliminary Essay upon the Systematic Arrangement of the Fishes of the Devonian Epoch,' and therein suggested that *Ceratodus* was a Ctenodipterine fish and ranged it (with a mark of interrogation) by the side of *Dipterus*. He also drew 'attention to the many and singular relations which obtain between that wonderful and apparently isolated fish, *Lepidosiren*,' and the Ctenodipterine fishes. (The exact truth was not discovered, but was approximated.) Is it not probable that this memoir was known to Clarke, who claimed to have suggested to Krefft the systematic relations of newly discovered Australian dipnoan? It was creditable to both Clarke and Krefft that they did recognize this relationship and profited by their bibliographical knowledge, but it is doubtful whether they would have been able to make the identification or appreciate the importance of the discovery had not Huxley prepared partly the way. By this discovery, our acquaintance with the ichthyic faunas of both the present and past was almost revolutionized.

Among the most important results of Huxley's investigations were the discovery and approximately correct recognition of the nature of the 'peculiar gelatinous bodies' found in all the seas, whether extra-tropical or tropical, through which the 'Rattlesnake' sailed, and which were named *Thalassicola*, precursors of radiolarian hosts afterwards to be brought to light; the appreciation of the closeness of the relations between birds and reptiles, the destruction of the old basis for the classification of birds, the recognition that mammals may have originated from a low type of Vertebrates and even the Amphibians, and the perception of the comparative affinities of the southern forms of Astacoidean crustaceans and their contrast as a group with the forms of the northern hemisphere. I must resist the temptation to further enumerate the great naturalist's discoveries and generalizations, but finally let me add that not the least of his services to science was destructiveness in the death-blow he gave to the vertebral theory of the skull at one time so generally accepted in England and this country.

V.

While the contest between the old and new schools of biological philosophy was at its height, the former was almost entirely supported by the religious element and bitter were the invectives against evolution. The opposition was almost solely based on

* The great English morphologists (such as Balfour and Ray Lankester) and A. Smith Woodward among systematic ichthyologists have recognized the heterogeneity of the old class of fishes.

the ground that the doctrine was in opposition to revealed religion. The naturally combative disposition of Huxley was much aroused by this opposition, and the antagonism early engendered was kept aglow during his entire life. Meanwhile it had been discovered by many of the more sagacious and learned clergymen that there was no real antagonism between the Scriptural account of Creation and evolution, but that the two could be perfectly reconciled. The reconciliation had been effected between Genesis and astronomy and between Genesis and geology, and was continued on the same lines for Genesis and evolution. But Huxley would have none of it. He gave expression to his convictions in the following words:

"For more than a thousand years, the great majority of the most highly civilized and instructed nations in the world have confidently believed and passionately maintained that certain writings, which they entitle sacred, occupy a unique position in literature, in that they possess an authority, different in kind, and immeasurably superior in weight, to that of all other books. Age after age, they have held it to be an indisputable truth that, whoever may be the ostensible writers of the Jewish, Christian, and Mahometan Scriptures, God Himself is their real author; and, since one of the attributes of the Deity excludes the possibility of error and—at least in relation to this particular matter—of wilful deception, they have drawn the logical conclusion that the denier of the accuracy of any statement, the questioner of the binding force of any command, to be found in these documents is not merely a fool, but a blasphemer. From the point of view of mere reason he grossly blunders; from that of religion he grievously sins.

"But, if this dogma of Rabbinical invention is well founded; if, for example, every word in our Bible has been dictated by the Deity; or even if it be held to be the Divine purpose that every proposition should be understood by the hearer or reader in the plain sense of the words employed (and it seems impossible to reconcile the Divine attribute of truthfulness with any other intention), a serious strain upon faith must arise. Moreover, experience has proved that the severity of this strain tends to increase, and in an even more rapid ratio, with the growth in intelligence of mankind and with the enlargement of the sphere of assured knowledge among them.

"It is becoming, if it has not become, impossible for men of clear intellect and adequate instruction to believe, and it has ceased, or is ceasing, to be possible for such men honestly to say they believe that the universe came into being in the fashion described in the first chapter of Genesis; or to accept, as a literal truth, the story of the making of woman with the account of the catastrophe which followed hard upon it, in the second chapter; or to admit that the earth was repeopled with terrestrial inhabitants by migration from Armenia to Kurdistan, little more than 4,000 years ago, which is implied in the eighth chapter; or finally, to shape their conduct in accordance with the conviction that the world is haunted by innumerable demons, who take possession of men and may be driven out of them by exorcistic adjurations, which pervades the Gospels."

So far even Huxley was not in disagreement with some of the most eminent and learned of theologians. Those of you who are interested will be able to recall utterances of enlightened clergymen which would differ from Huxley's only in the absence of the leaven of sarcasm that permeates his lines. At a late Congress of the Church of England, held at Norwich, the Rev. Canon and Professor Bonney gave voice to words that convey the same ideas as Huxley's.

"I cannot deny," he said, "that the increase of scientific knowledge has deprived parts of the earlier books of the Bible of the historical value which was generally attributed to them by our forefathers. The story of the Creation in Genesis, unless we play fast and loose either with words or with science, cannot be brought into harmony with what we have learned from geology. Its ethnological statements are imperfect, if not sometimes inaccurate. The stories of the Flood and of the Tower of Babel are incredible in their present form. Some historical element may underlie many of the traditions in the first eleven chapters of that book, but this we cannot hope to recover."

But Huxley was not content to deny any authority to the Scriptural basis of most of the religions of Europe and America. He denied that there was any means of knowing what the future had in store. He did not deny that there was a heaven or a hell; he did not deny that in a future world man might continue in a sublimated state, and might be punished for his misdeeds or rewarded for the good deeds he had performed and for good thoughts on earth. He did not venture to express any opinion on the subject for the reason that he had no data to base an opinion upon. He called himself an agnostic and the attitude he assumed was agnosticism.

This term agnostic, we are told by Mr. R. H. Hutton, was suggested by Prof. Huxley at a party held previous to the formation of the now defunct Metaphysical Society, at Mr. James Knowles' house on Clapham Common, one evening in 1869, and was suggested by St. Paul's mention of the altar to the unknown God—*'Αγνώστῳ Θεῷ*.

But Huxley has explained that he assumed this term in contradistinction to the gnostic of old. The gnostic claimed to know what in the nature of things is unknowable, and as Huxley found himself with an exactly opposite mental status, he coined a word to express that antithetical state—agnostic.

I have done all I conceive to be necessary in giving this statement of Huxley's attitude. Whether he was right or wrong, each one must judge for himself or herself. Believing as he did, on a bed of prolonged illness he resignedly awaited the inevitable, and desired that his sentiments reflected in verse by his wife should be engraved on his tomb.

> "And if there be no meeting past the grave,
> If all is darkness, silence, yet 'tis rest.
> Be not afraid, ye waiting hearts that weep
> For God 'still giveth his beloved sleep,'
> And if an endless sleep he wills—so best."

THEO. GILL.

CERTITUDES AND ILLUSIONS.

CHUAR'S ILLUSION.

IN the fall of 1880 I was encamped on the Kaibab plateau at the edge of the forest above the canyon gorge of a little stream. White men and Indians composed the party with me. Our task was to make a trail down this side canyon into the depths of the Grand Canyon of the Colorado. While in camp after the day's work was done, both Indians and white men engaged in throwing stones across the little canyon, which was many hundreds of feet in depth. The distance from the brink of the wall on which we were camped to the brink of the opposite wall seemed not very great, yet no man could throw a stone across the chasm, though Chuar, the Indian chief, could strike the opposite wall very near its brink. The stones thrown by others fell into the depths of the canyon. I discussed these feats with Chuar and led him on to an explanation of gravity. Now Chuar believed that he could throw a stone much farther along the level of the plateau than over the canyon. His first illusion was thus one very common among mountain travelers—an underestimate of the distance of towering and massive rocks when the eye has no intervening objects to divide the space into parts as measures of the whole.

I did not venture to correct Chuar's judgment, but simply sought to discover his method of reasoning. As our conversation proceeded he explained to me that the stone could not go far over the canyon, for it was so deep that it would make the stone fall before reaching the opposite bank; and he explained to me with great care that the hollow or empty space pulled the stone down. He discoursed on this point at length, and illustrated it in many ways: "If you stand on the edge of the cliff you are likely to fall; the hollow pulls you down, so that you are compelled to brace yourself against the force and lean back. Any one can make such an experiment and see that the void pulls him down. If you climb a tree the higher you reach the harder the pull; if you are at the very top of a tall pine you must cling with your might lest the void below pull you off."

Thus my dusky philosopher interpreted a subjective fear of falling as an objective force; but more, he reified void and imputed to it the force of pull. I afterward found these ideas common among other wise men of the dusky race, and once held a similar conversation with an Indian of the Wintun on Mount Shasta, the sheen of whose snow-clad summit seems almost to merge into the firmament. On these dizzy heights my Wintun friend expounded the same philosophy of gravity.

Now in the language of Chuar's people, a wise man is said to be a traveler, for such is the metaphor by which they express great wisdom, as they suppose that a man must learn by journeying much. So in the moonlight of the last evening's sojourn in the camp on the brink of the canyon, I told Chuar that he was a great traveler, and that I knew of two other great travelers among the white men of the East, one by the name of Hegel and another by the name of Spencer, and that I should ever remember these three wise men, Chuar, Hegel and Spencer, who spoke like words of wisdom, for it passed through my mind that all three of these philosophers had reified void and founded a philosophy thereon.

In the history of philosophy an illusion is discovered concerning matter and each of the constituents or categories of matter, which are number, extension, motion, duration and judgment; and as bodies are related elements of matter, relation itself comes to be the object of illusion. Matter is the substrate of all bodies; bodies thus have a substrate, and the illusion of matter arises from supposing that matter, which is the substrate, has also its substrate, which is sometimes called essence. Classes are orders of number; the illusion of number relates to class or kind, and this is also usually called essence. Extensions combined have figure and structure, which produce form, and the illusion of extension is an illusion in relation to forms which are derived from extensions, and is called space. Motions through collisions are forces, and the illusion relating to motion is also called force. Duration is persistence and change, which give rise to time, and the illusion of duration is called time. Judgment is consciousness and inference, which give rise to comprehension of ideas, and the illusion of idea is called ghost. Bodies are related to one another, hence numbers, extensions, motions, durations and judgments are related. Certain of the relations of these things are called cause, and the illusion of relation also is called cause.

Now it must be clearly understood that the terms substrate, essence, space, force, time, ghost and cause refer sometimes to real things, as when properly used in science, and sometimes to illusions, when they are improperly used, as they often are in metaphysics; but usually the word ghost is now used only in reference to an illusion, and this is the sole case where we have a term for an illusion which is commonly understood in that sense, but the term spirit is used in both senses, for the certitude and for the illusion.

The seven illusions here enumerated are perhaps the most fundamental and far-reaching of the vast multitude of illusions which appear in the history of error. The words substrate, essence, space, force, time, ghost and cause are terms of universal use and their synonyms appear in all civilized languages, and perhaps in all lower languages. They have always stood for certitudes and illusions; here they require definitions both as certitudes and as illusions, in so far as we are able to define them.

SUBSTRATE.

Substrate is matter, matter is the substrate of all bodies. Essence is any collocation of units into a unit of a higher order which makes it a kind or one of a class. Space is any extension or any collocation of extensions; force is any collocation of motions that are related by collisions; time is any duration or collocation of durations; mind or spirit or ghost is any cognition or collocation of cognitions; cause is any related antecedent or collocation of such antecedents of a change. Such are the fundamental meanings of the words when used to designate realities. We shall hereafter see what they mean when they are used to designate illusions. Matter is the substrate of body and has no substrate for itself. All matter has four factors or constituents, number, extension, motion and duration, and some matter at least has a fifth factor, namely judgment. Matter is not a substrate for these factors, but exists in these constituents which are never dissociated, but constitute matter, or are the moments of matter; and this matter is the substrate of all bodies.

ESSENCE.

The term essence as used in philosophy is employed in a double manner and is thus often ambiguous. It is sometimes used as a synonym for substrate of matter, at other times it is used to designate the occult substrate of class. In this latter sense it is here used. Essence, then, is the number essential to make an order or kind of a class. As the whole number is essential, every one is essential; they are severally and conjointly essential, so that it is possible correctly to speak of them all as being essential and to speak of every one severally as being essential. All of the particles which make up a body are conjointly and severally essential to that body, and the essence of a body is the hierarchy of particles of which it is composed. The term essence, therefore, is a general term or pronoun for all collocations of number, and its special meaning is derived from the context. As an illusion, essence is the name of an unknown something which produces a kind or class, and is a property of an unknown or unknowable substrate of matter.

If, as the chemist believes, with much good reason, the ultimate chemical particles are alike, they are alike only in number, extension, motion and duration; they are unlike in association, position, direction or motion and the duration of association, so that likeness and unlikeness is inherent in matter itself. In bodies innumerable combinations of number, extension, motion and duration are found, and out of these are developed innumerable likenesses and unlikenesses, so that one body is like another in many respects and unlike that other in many other respects. The science of classification takes these likenesses and unlikenesses and discovers degrees among them which are of profound importance in the study of the world, and upon which a large share of knowledge rests. All knowledge does not rest upon likeness and unlikeness; but likeness is founded upon number, and men have discovered that what is true of a body is true of any other body of like kind, under the axiom that whatever is true of anything is true of its identity in so far only as it is a constant property or an absolute, and not in so far as it is a variable or relative. These are all simple, self-evident propositions, but in the compounding and recompounding of matter it is not always possible to disentangle the constants from the variables. Men lost in the meaning of words, forever wandering in linguistic jungles, have engaged in discussions about essences and have at last reified the word as something which is not number associated with extension, motion and duration, but as some occult existence unknown and unknowable, which gives to bodies their likeness or unlikeness. Having reached the conclusion that matter is something more than its constituents, with an occult, unknown and unknowable substrate, they take the next step that the essence of class or likeness and unlikeness exists not in the fundamental properties of body or the fundamental constituents of matter, but in their substrate.

All known things are classified either properly or improperly. The characters upon which they are classed are thus innumerable. These characters which constitute class are all the bodies embraced in the class and all the properties embraced in all the bodies of the class. The term essence, then, used in this sense, means all of these things. Therefore it is a general name for everything in the universe, but obtaining its particular meaning in any case by the context. What is the meaning of the word *this?* It may be applied to any constituent of matter, to matter itself, to any body or to any property, relation or quality in the material world, and to any idea in the mental world, and its meaning is derived from the context; it has no definite meaning in itself. *Essence*, as a word used by philosophers, is a pronoun of like character without specific meaning, and attains its specific meaning only by the context; it has one meaning at one time, and another at another, and thus it seems to be illusive. As the substrate of matter, a reified nothing, is entertained in the minds of some as an entity, so some thinkers make essence a property of this substrate—a nonenity of a nonenity. Chuar, Hegel and Spencer reason in this manner. Essence as connoting the essential characters of a class is a word the meaning of which scientific men clearly understand; it is never ambiguous, although naturalists may sometimes disagree about the essentiality of a particular character, but the essence of which the philosopher thinks is nonexistent, the opinions of the three wise men to the contrary notwithstanding.

SPACE.

The word space is the pronoun of all extensions, figures and structures of extensions in the multitudinous bodies of the world. There are many extensions, and every known body is a constituent of some other body, and this synthesis may be continued until the mind is lost in immensity. The space occupied by a body is its extension in structure and figure. This desk before me has extension, or we say that it occupies space; the space which it occupies is its extension, from which it excludes other bodies. Remove the furniture from the room, it is said to be empty, yet it is full of air; remove the air from the room, yet it is full of ether; remove the ether, may be, we know not, all is removed; then the wall encloses void—nothing—but the walls of the room yet have extension, and we can measure this by measuring the walls, but void cannot be measured; there is nothing to be measured. Thus it is that space is the pronoun of all dimensions of all bodies, severally and conjointly, and as they are variable, space seems to be illusive, and it comes at last in the minds of careless thinkers to mean something more than extension, an unknown and unknowable thing that, like essence, belongs to the unknown and unknowable substrate of matter. The word is useful when its use is understood as a pronoun or general word whose meaning is given by the context.

FORCE.

Force is the pronoun for combinations of motion. It thus may be applied to numerous things now existing, or which have existed in the past or may exist in the future. It is the general word for all collisions and all combinations of collisions; collisions of particles of ether in light and heat, collisions of particles of air in sound, collisions of particles of water in stress, collisions of particles of matter in all solids exhibited in the structure and strength of those materials. It thus stands for the action of two or more bodies as they come in collision, and thus influence each other's motions. It is not an occult, unknown or unknowable something which belongs to an occult, unknown and unknowable substrate. The term has no particular or determined meaning in itself, but derives its meaning from the context. It is a word of universal use, whose meaning must be determined by its application; it is the general term or pronoun to denote any or all actions and reactions.

TIME.

Time is the pronoun of all durations. It means any duration to which the term is applied, all durations or any collocation of durations the mind may entertain. When reified it comes to be thought of as applying to an existence independent of the things which have duration. Then time, like essence, space and force, becomes a property of the substrate of matter, an illusion about an illusion.

GHOST.

Spirit is a general term or pronoun for all judgments in the infinite variety of sensations, perceptions, understandings, acceptions and reflections. It is a name for all ideation. It is known to us only in its association or connection with the universal constituents of matter, which are number, extension, motion and duration. There is no spirit which is not a unity of many and one. There is no spirit which has not force. There is no spirit which has not duration; in so far all are agreed; and it is here affirmed that there is no spirit which has not extension, for without extension all the other constituents would vanish, become nothing, absolutely unimaginable or unthinkable. When spirit is considered to be something which is not number or many in one, which has not extension with figure and structure without force, or the power of action and reaction and without duration as persistence or persistence and change, that is, without time, it becomes a nonentity, a nothing, and it is then an illusion and is usually called ghost.

CAUSE.

We use the word cause as we use the words *this* and *that*, as a general term or pronoun for anything that stands in relation to any other thing in the production of a change. The multitudinous bodies and particles of the universe coöperate with one another in the production of changes. The condition before a particular change is considered in respect to the condition after the change, and the condition which coöperated in the production of the change, is called a cause, and the condition after the change is called an effect. It is thus that the term cause may be applied to any body, to any property, or to any relation; it is a term for any of these things, any collocation of these things or any part of these things, and just what its meaning may be can be discovered only by the context in which the word is used. In the multitude of bodies, properties and relations which coöperate in the production of the change whose result is called an effect, we may stop to consider any one and call that the cause. Failing to appreciate the variable significance of the word, men are led into the illusion that there is some entity, some separate existence called cause.

Metaphorically, essence is sometimes used for space, sometimes for force, sometimes for time, sometimes for spirit, and sometimes for cause, and interchangeably all of these terms may be used as metaphors for one another.

Thus it is that we have a family of chimeras in substrate, essence, space, force, time, ghost and cause that are not bodies or the properties of bodies, but things non-existent—mysteries that are at the foundation of all philosophies of the unknowable and all philosophies of the contradictory, and the ground of all antinomies. They constitute the substrate, the essence, the space, the time, the cause of the philosophies of the three wise men, Chuar, Hegel and Spencer.

We shall hereafter see more clearly how these illusions have been developed and how other illusions have gathered about them. Here we simply call attention to the fundamental illusions to indicate somewhat the purposes of this argument.

It is within the experience of every human being, and has been through all generations, that man is forever discovering number, extension, motion, duration and judgment. He learns something of number in infancy and adds to his knowledge daily and extends his knowledge to an indefinite multiplicity. He adds to his knowledge the extension of one body and another still embodied in a higher order; and thus his knowledge of extension increases to an indefinite extent. He is forever discovering new motions and new combinations of motions as forces and finds that he is able thus to add more and more of like motions and forces to his knowledge. Ever he is discovering durations – the durations of coexistent things and the durations of past things, extending to high antiquity, and he prophesies durations to come, and many do come, until his mind is led into the illimitable future. Mind is then trained by constant experience to expect a further enlargement of knowledge and to consider the possibilities into which it may expand, until it dwells upon endless number, endless extension, endless force, endless duration. Man contemplates multiples and submultiples of the things of which he already has knowledge, and then invents implements of research by which submultiples are discovered, and other implements by which multiples in higher orders are discovered. Finding that he has explored but a small part of the universe, and that within the universe wherever bodies are to be met they have been resolved into numbers, extensions, motions and durations, he grasps the idea of infinity not as something other than that of which he knows, but as more of that which he best knows. The experience of men through countless generations has organized the concepts of number, extension, motion and duration as the universal factors of matter, and never has any mind discovered any other things saving only those which are included in the terms of mind. Of matter without mind, man has absolutely no vestige of knowledge which is not included under the terms number, extension, motion and duration. These terms absorb them all. Therefore matter is number, extension, motion and duration, and at least some matter has judgment.

The mind discovers another factor or category in the universe—judgment, which develops into cognition of the constituents of matter, of their relations, and also a cognition of cognitions and the relations of cognitions. It is thus that the universe is resolved into material elements and judgments, the five things best known, and science in dealing with the universe explains them by resolving them into these best known things. Science does not lead to mystery, but to knowledge, and the mind rests satisfied with the knowledge thus gained when the analysis is complete—when any newly discovered body is resolved into its constituents or any new idea into its judgments.

Concepts of number, extension, motion, duration and judgment are developed by all minds; from that of the lowest animal to that of the highest human genius. Through the evolution of animal life, these concepts have been growing as they have been inherited down the stream of time in the flood of generations. It is thus that an experience has been developed, combined with the experience of all the generations of life for all the time of life, so that it is impossible to expunge from human mind these five concepts. They can never be cancelled while sanity remains. Things having something more than number, extension, motion, duration and judgment cannot even be invented; it is not possible for the human mind to conceive anything else, but semblances of such ideas may be produced by mummification of language.

Ideas are expressed in words which are symbols, and the word may be divested of all meaning in terms of number, extension, motion, duration and judgment and still remain, and it may be claimed that it still means something unknown and unknowable; this is the origin of reification. There are many things unknown at one stage of experience which are known at another, so man comes to believe in the unknown by constant daily experience; but has by further converse with the universe known things previously unknown, and they invariably become known in terms of number, extension, motion, duration and judgment, and are found to be only combinations of these things. It is thus that something unknown may be imagined, but something unknowable cannot be imagined.

No man imagines reified substrate, reified essence, reified space, reified force, reified time, reified ghost, or reified cause. Words are blank checks on the bank of thought, to be filled with meaning by the past and future earnings of the intellect. But these words are coin signs of the unknowable and no one can acquire the currency for which they call.

Things little known are named and man speculates about these little known things and erroneously imputes properties or attributes to them until he comes to think of their possessing such unknown and mistaken attributes. At last he discovers the facts; then all that he discovers is expressed in the terms of number, extension motion, duration and cognition. Still the word for the little known thing may remain to express something unknown and mystical, and by simple and easily understood processes he reifies what is not, and reasons in terms which have no meaning as used by him. Terms thus used without meaning are terms of reification.

Such terms and such methods of reasoning become very dear to those immersed in thaumaturgy and who love the wonderful and cling to the mysterious, and, in the revelry developed by the hashish of mystery, the pure water of truth is insipid. The dream of intellectual intoxication seems more real and more worthy of the human mind than the simple truths discovered by science. There is a fascination in mystery and there has ever been a school of intellects delighting to revel therein, and yet, in the grand aggregate, there is a spirit of sanity extant among mankind which loves the true and simple.

Often the eloquence of the dreamer has even subverted the sanity of science, and clear-headed, simple-minded scientific men have been willing to affirm that science deals with trivialities, and that only metaphysics deals with the profound and significant things of the universe. In a late great text-book on physics, which is a science of simple certitudes, it is affirmed:

To us the question, *What is matter?*—What is, assuming it to have a real existence outside ourselves, the essential basis of the phenomena with which we may as physicists make ourselves acquainted?—appears absolutely insoluble. Even if we become perfectly and certainly acquainted with the intimate structure of what we call Matter, we would but have made a further step in the study of its properties; and as physicists we are forced to say that while somewhat has been learned as to the properties of Matter, its essential nature is quite unknown to us.

As though its properties did not constitute its essential nature.

So, under the spell of metaphysics, the physicist turns from his spectroscope to exclaim that all his researches may be dealing with phantasms.

Science deals with realities. These are bodies with their properties. All the facts embraced in this vast field of research are expressed in terms of number, extension, motion, duration and judgment; no other terms are needed and no other terms are coined, but by a process well known in philology as a disease of language, sometimes these terms lapse into meanings which connote illusions. The human intellect is of such a nature that it has notions or ideas which may be certitudes or illusions. All the processes of reasoning, including sensation and perception, proceed by inference; the inference may be correct or erroneous, and certitudes are reached by verifying opinions. This is the sole and only process of gaining certitudes. The certitudes are truths which properly represent noumena, the illusions are errors which misrepresent noumena. All knowledge is the knowledge of noumena, and all illusion is erroneous opinion about noumena. The human mind knows nothing but realities and deals with nothing but realities, but in this dealing with the realities—the noumena of the universe—it reaches some conclusions that are correct and others that are incorrect. The correct conclusions are certitudes about realities; the incorrect conclusions are illusions about realities. Science is the name which mankind has agreed to call this knowledge of realities, and error is the name which mankind has agreed to give to all illusions. Thus it is that certitudes are directly founded upon realities; and illusions as they are always about realities, are thus indirectly, though incorrectly, founded upon realities, but certitudes and illusions alike all refer to realities. In this sense then it may be stated that all error as well as knowledge testifies to reality, and that all our knowledge is certitude based upon reality, and that illusions would not be possible were there not realities about which inferences are made.

Known realities are those about which mankind has knowledge; unknown things are those things about which man has not yet attained knowledge. Scientific research is the endeavor to increase knowledge, and its methods are observation, experience and verification. Illusions are erroneous inferences in relation to known things. All certitudes are described in terms of number, extension, motion, duration and judgment; nothing else has yet been discovered and nothing else can be discovered with the faculties with which man is possessed.

In the material world we have no knowledge of something which is not a unity of itself or a unity of a plurality; of something which is not an extension of figure or an extension of figure and structure; of something which has not motion or a combination of motions as force; of something which has not duration as persistence or duration with persistence and change.

In the mental world we have no knowledge of something which is not a judgment of consciousness and inference; of a judgment which is not a judgment of a body with number, extension, motion and duration. Every notion of something in the material world devoid of one or more of the constituents of matter is an illusion; every notion of something in the spiritual world devoid of the factors of matter and judgment is an illusion. These are the propositions to be explained and demonstrated.

In the following chapters an attempt will be made to show that we know much about matter, and although we do not know all, all we know is about matter in its categories of number, extension, motion, duration and judgment, or that we know of matter in its four categories and that we know of mind in the categories of judgment, but always this mind is associated with matter. In doing this we shall endeavor to discriminate between the certitudes and illusions current in human opinion.

In the intoxication of illusion facts seem cold and colorless, and the wrapt dreamer imagines that he dwells in a realm above science—in a world which as he thinks absorbs truth as the ocean the shower, and transforms it into a flood of philosophy. Feverish dreams are supposed to be glimpses of the unknown and unknowable, and the highest and dearest aspiration is to be absorbed in this sea of speculation. Nothing is worthy of contemplation but the mysterious. Yet the simple and the true remain. The history of science is the history of the discovery of the simple and the true; in its progress illusions are dispelled and certitudes remain.

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NOTES ON THE DENSITY AND TEMPERATURE OF THE WATERS OF THE GULF OF MEXICO AND GULF STREAM.*

IT is estimated that the evaporation in the Gulf of Mexico amounts to about 60 inches a year, thus diminishing the amount of water in the Gulf 1.54 cubic miles per day. The evaporation is greatest in the central parts of the Gulf, following a line from east to west and approximately coinciding with the line of mean maximum of atmospheric pressure.

Precipitation, on the other hand, is greatest in the southwestern and northeastern parts of the Gulf, and least in the area intervening between the sandy plains of Yucatan and the arid regions of southern Texas and northern Mexico. By computation we find it to reach 32.7 inches annually, which is about 55 per centum of the evaporation, and it increases the waters of the Gulf by 0.84 cubic miles per day.

The water supply is further increased by river discharges, which amount to about 0.68 cubic miles per day; nearly 70 per centum of this volume being furnished by the Mississippi River. It will be seen that precipitation and river discharges feed the gulf by nearly the same amounts, but the effect produced by those feeders sinks into insignificance when compared with that produced by the inflowing current of the Yucatan Channel, which, according to a calculation from Lieut. Pillsbury's current observations, hurls the enormous quantity of 652 cubic miles of water per day into the Gulf, which quantity by itself would suffice to raise the level of the entire Gulf $5\frac{3}{4}$ feet within that space of time.

The Gulf stream carries off only about two-thirds of the water that is added to the volume of the Gulf in the manner indicated above, and evaporation being power-

* Abstract of a paper read to the Philosophical Society of Washington, by permission of the Superintendent of the U. S. Coast and Geodetic Survey.

less to remove the other third we are led to the conclusion that it flows back into the Caribbean as an undercurrent.

A study of the proportions of these currents has led to the conclusion that the Yucatan Channel current owes its existence mainly to the mechanical effect of the winds which produce an accumulation of waters in the northwestern part of the Caribbean Sea, but it is also, in part, due to differences in temperature and density between the waters of the latter and those of the Gulf. Hence, should the winds cease to influence the level of the Caribbean Sea, there would still be a surface current from this sea into the Gulf and an undercurrent in the opposite direction, similar to those which actually exist in the Strait of Gibraltar from and to the Atlantic Ocean.

The fresh water, which finds its way into the southwestern part of the Gulf, remains on the surface of the Gulf waters, but on account of its high temperature it readily assimilates with the sea water, and by continuous absorption of salt and heat from the lower strata reduces the latter to abnormally low temperatures.

The river and rainwater entering the northern parts of the Gulf also remains on the surface, but it preserves its distinctive character and low specific gravity for a much longer time period, owing to its comparatively low temperature, for not until it has reached the middle of the Gulf has it gathered salt and heat to its full capacity. Thus the course of the waters of the Mississippi River can be traced by their lightness for hundreds of miles into the Gulf of Mexico. Instead of flowing directly southeast towards the Strait of Florida, in accordance with the generally accepted supposition, these waters flow to the westward, which deflection undoubtedly is influenced by the existence of a lower water level in the western part of the Gulf, due to the piling up of the water in the eastern part by the flow from the Yucatan Channel. Notwithstanding the fact that the tendency of the Mississippi River waters, after entering the Gulf, is towards the west, and regardless of the strength of the inflowing Yucatan current, the predominent surface drift of the Gulf is towards the Strait of Florida, which phenomenon may be explained by assuming that the Yucatan current in its west and northward progress dips below the surface waters and continues as an undercurrent.

The surface waters of the central and eastern parts of the Gulf of Mexico, being propelled against the direction of the prevailing winds, are subjected to a powerful influence of evaporation, by which their specific gravity is increased to such an extent that their weight can no longer be borne on the surface, and sinking, they carry larger amounts of salt and heat into the deep strata than could reach such great depths in any other way. Thus only can we account for such temperatures as 60° and more at a depth of 250 fathoms, occurring off Cape San Antonio, half way between the Florida and Campeche Banks, against 44° in the western part of the Gulf and 47° in the Caribbean Sea at corresponding depths.

In conformity with the direct effects, known to result from decided differences of temperature at considerable depths in communicating parts of the ocean, there will be an undercurrent from the southeastern part of the Gulf toward the western part and another entering the Caribbean Sea, supporting the views expressed when considering the volume of water.

It is a remarkable phenomenon that the temperature in the substrata of those parts of the ocean adjacent to the Strait of Florida should be so nearly the same as that of the eastern part of the Gulf, thus precluding the existence of a subsurface counter-current in that strait; and a singular coincidence may be noted in the general character of the bed of that strait, it being only sufficiently deep to permit the passage of the Gulf Stream. It must not be supposed, however, that the under-current flowing into the Caribbean Sea entails a permanent saline and thermal loss upon the waters of the Gulf, as those abducted quantities of salt and heat, by a system of transfers, find their way into consecutively higher levels, and finally reach the surface current and return with it to the Gulf.

The current of the Yucatan Channel, notwithstanding its being the strongest current of the entire Gulf Stream system, possesses no great depth, and owing to its rapid spreading out it soon loses the best part of its velocity. The only exception in this respect is met with along the northern edge of Campeche Bank, where its flow shows considerable vitality, and it is here that it has evidently taken the shortest route to reach the western part of the Gulf.

It also appears to be very variable in its strength; when flowing at its best some of its waters are sent into the Strait of Florida, but its main strength is directed against the Gulf of Mexico with the effect of penning up its waters above the level of the Atlantic. Whenever the Yucatan current relaxes in activity, the waters of the Gulf of Mexico, in their reaction, frequently succeed in cutting it off altogether from reaching the Strait of Florida, and sometimes even in partly forcing it back at its eastern and weakest flank, into the Caribbean Sea.

The Gulf Stream, as has been shown by Lieutenant Pillsbury, is not the direct continuation of the Yucatan Channel current, but originates about in the middle of the western entrance to the Strait of Florida.

As it first appears in the Strait it is comparatively an insignificant current, and we are also disappointed in not finding it that fiery furnace which, according to its reputation, transmits sufficient heat to the eastern part of the Atlantic to modify the climate of the whole of western Europe. The fact appears to be that it does not start upon its journey at this point with more heat than it requires for its own use until it reaches Cape Florida, as it at once enters a contest against the cold waters descending from the Florida Bank, extending nearly halfway across the Strait. During its progress through the Strait these cold waters are forced back into the vicinity of the reefs, and by the time the Gulf Stream has reached Cape Florida it is in full possession of the Strait, from the surface to the bottom, and from the Bahama Banks to the Florida Reefs; its axis being but 15 miles distant from Cape Florida.

This victory, however, has been obtained at a great sacrifice of its supply of salt and heat, leaving it in an inadequate condition to engage unaided in another contest which it must immediately enter upon. Fortunately reinforcements are at hand, warm and highly saline waters, which have been slowly advancing along the Bahama Bank, join the Gulf stream at its point of weakness. Other and far more important succor gathered by the northeast trade winds, joins the Gulf stream on entering the ocean at the eastern end of the strait. Yet all these additions cannot account for the observed fact that the waters of the Gulf stream are so much warmer and more saline than those of the ocean, and in order to discover the source of this great heat we must look in a different direction than towards the Gulf of Mexico, or towards the surface drift of the Atlantic.

What has been described as taking place on the surface of the southeastern part of the Gulf is reënacted on a much larger scale on the entire surface of that part of the Atlantic Ocean lying between the Bermudas and the 'continental shelf,' off the Southern States. A powerful evaporation caused by the trade winds produces a condensation of the warm surface water, which sinks into greater depths and imparts a higher degree of temperature and salinity to the substrata than are met with in any other ocean. The waters of these substrata having a temperature from 60 to 64 degrees, at a depth of 250 fathoms, meet the cold waters, in a space about 40 miles wide, descending along the edge of the continental slope, which at the same depth (250 fathoms) have a temperature of only about 45 degrees.

Within this space of forty miles' width a transition of heat and salt is effected, resulting in an entire reconstruction of the superincumbent stratum of water, producing that peculiar distribution of salt and heat at the surface that is characteristic of the Gulf stream. When warm seawater comes into contact with colder seawater it becomes heavier, for the reason that the increase of density, due to loss of heat, surpasses the decrease, due to the loss of salt. When this occurs in the depths of the ocean the warm water will sink to still greater depths, but here (as also on the slopes of great submarine banks like the Bahama, Florida and Campeche Banks) this dense and warm water touches bottom, and another shift must be made to dispose of the excess of salt, the maintenance of equilibrium being a physical necessity.

The density of warm water is less affected by the addition of a certain quantity of salt than cold water would be, and for this reason the excess of salt and heat at the bottom, on the inner edge of the Gulf Stream, shifts to higher levels where, in consequence of higher temperatures, larger quantities of salt can be stowed away with less change of density than at greater depths. Thus, by a withdrawal of salt and heat from the greater depths and their accumulation at the surface, that peculiar distribution is attained which characterizes all the serial temperature observations of the Gulf Stream sections, including those obtained by the Challenger.

Observations show the highest specific gravities of the Gulf Stream waters to be in the latitudes of Capes Lookout and Hatteras, exceeding those of all other parts of the open ocean, and surpassed only by those of the Red Sea and of the western part of the Mediterranean.

Although the 'upheaval' of the waters of the Gulf Stream develops first in upward currents, in the substratum in which the transition of heat and salt begins, it is not improbable that these currents, like the winds in aërial circulation, may assume a more or less horizontal direction in their progress to the surface. It may also be assumed that the storage of heat in the surface stratum is not without influence upon the level of the Gulf Stream, and that this difference of level between the Gulf Stream and the adjacent areas of the ocean may call other currents into life, but a farther consideration of these subjects would lead us into the sphere of the so-called dynamics of the Gulf Stream, a field already ably discussed and sufficiently studied.

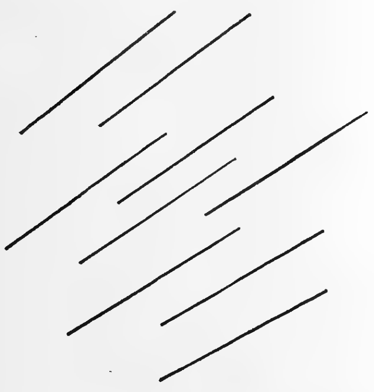
A. LINDENKOHL.

AN OPTICAL ILLUSION.

THE brilliant electric lights on the borders of the lake in the Baltimore park have served to call my attention to a phenomenon which is so very familiar that one is wholly disinclined to regard it as a 'phenomenon' at all. I refer to the fact that the long stream of light reflected by the surface of the water from a lamp on the opposite side does not look like an object lying upon the surface, but like a bright post projecting down into the water, in continuation of the lamp-post. This is without doubt a particular case of the illusion by which lines which have any position whatever in planes passing through the axis of the body (or, for small near objects, in planes passing through the vertical meridian of the one eye with which they are looked at)* are taken by us to be vertical lines. This illusion is illustrated in Fig. 1. The lines of the figure are all drawn through a common point about three inches beyond the corner of the paper. If one eye be put in the position of this point (the other being closed), and if the paper be held horizontally about on the level of the eye, the lines will all seem to stand upright. The reason is that when one eye only is used, we have very small ground for knowing how such a line is situated in the plane determined by it and by the nodal point of the eye, and hence we take it to be a vertical line *faute de mieux*, because by far the greatest number of lines which strike the retina in this meridian are vertical lines. With many lines, the illusion is stronger than with one, because every group of vertical staves that we have ever seen has looked like this, and it has probably never happened to us to see a group of lines lying on the ground in just this position.

That this is the correct explanation of the phenomenon of the lights is confirmed by the fact that, upon looking at the reflection with the head inclined through an angle of ninty degrees, the illusion wholly disappears. One can no longer believe that it is possible to see the stream of light otherwise than as lying flat upon the surface of the lake. In this case the image of the line of light falls along the eyes, from one to the other, or just as a line would do which went from right to left if the head were in its normal position. Such a line we have no tendency to see vertical, and hence we now see the streak of light where it really is on the surface of the water. With the head wholly inverted, the line becomes vertical again, but less strongly so than when the head is in the customary attitude.

CHR. LADD FRANKLIN.



**Am. Jour. of Psychology*, I., 101 and James' *Principles of Psychology*, II., 95.

CURRENT NOTES ON PHYSIOGRAPHY.

THE TERTIARY PENEPLAIN IN MISSOURI.

THE prevalent opinion that the 'mountains' of the dissected Ozark plateau in Missouri are old geographical features meets welcome contradiction in an essay by Keyes, State Geologist (Missouri Geol. Survey, viii., 1894, 317–352). The relatively even upland surface of the plateau is explained as a peneplain of denudation; and the dome-like form of the plateau today is regarded as the result of elevation since the close of the Tertiary. The general upland plain is dissected by steep-sided or canyon-like trenches, in which the process of deepening is still continued. "The last elevation is not yet ended, and the changes of level in the region are probably going on now as rapidly as they ever have in the past geological time" (p. 352). While the strata are nearly horizontal in the Ozark plateau, they are tilted in the Ouachita mountains, south of the broad valley of the Arkansas river, in the State of that name. Keyes regards the relatively even crest lines of the Ouachita ridges as representing the same peneplain as that of the Ozarks; the broad valley of the Arkansas being a trough of erosion between the two highland areas, 'due partly to structural peculiarities, but it is also due largely to other conditions,' the latter not being specified. "As a unit, the Tertiary peneplain was bowed up from the Red river to the Missouri."

It has for some time been desirable to fix the date of the Ozark peneplain, but unfortunately the evidence by which a Tertiary date is here assigned to the completion of the peneplain and a Post-Tertiary date to its uplift and dissection is not fully stated. The narrowness of the valleys may, however, certainly be taken to 'emphasize the fact that the Ozark uplift of to-day is essentially modern.'

HIGH LEVEL GRAVELS OF KENTUCKY.

THE rolling limestone uplands of the blue-grass region of Kentucky, rimmed around by sandstone escarpments on the south, and dissected by deep narrow valleys of streams that flow to the Ohio on the north, are strewn over at various places with gravels and sands. The distribution of the gravels is discussed by A. M. Miller, of Lexington, Ky. (Amer. Geol., XVI., 1895, 281–287). These loose materials are water-worn and bedded, and are derived mostly from the harder rocks of the enclosing escarpments; they are found chiefly near existing valleys. Miller concludes that within comparatively recent times the rivers were flooded to a height of 300 to 350 feet above their present channels. In explanation of such flooding, a glacial obstruction of the Ohio is considered as a possibility, but satisfactory evidence is not found in favor of it. 'Submergence' of unspecified nature is also mentioned without reaching any definite conclusion about it.

No consideration is given to the possibility that the gravels may have been spread over the upland surface before the present canyon-like valleys were eroded, while the whole region stood at a lower level than at present, but not submerged. This is eminently possible, for the aspect of the blue-grass region is strongly suggestive of base-levelling during a former lower stand of the land, and of dissection after elevation to the present altitude, as has been suggested by Westgate (Amer. Geol., XI., 1893, 258–259). The prepossession that the upland gravels could not endure for so long a time as would be needed to carve the canyon-like valleys is not well supported. Old river gravels lie on rock benches enclosing the gorge of the upper Ohio; and in similar position on the valley slopes of the Meuse in its transverse path across the Ardennes; even the fine loess of the upper bench of the Rhine valley in the Schiefergebirge is older than the narrow gorge of that energetic river.

CLOUD-BURST TRACKS AND WATER GAPS IN ALABAMA.

A REPORT on the Coosa coal field by A. M. Gibson (Alabama Geol. Survey, 1895) gives a description of two great scars on Coosa mountain, produced by cloud-bursts that accompanied the tornadoes of July, 1872. On the northwest side of the mountain there is a washout sixty feet wide and three or four feet deep, extending down the mountain side. Trees, soil and rocks were all swept down, making great moraine-like heaps at the base of the slope. On the southeast side of the mountain there are several scars of even greater magnitude. From one of these rocks of all sizes were carried down to the low ground and there heaped over 'acres of ground.' One mass, estimated to weigh a hundred tons was carried half a mile (p. 28–30).

It is to be regretted that the sanction of State publication should be given a few pages later to an antiquated account of 'Big Narrows' in Double mountain. "Some convulsion of nature must surely have made the break that let the waters enter here, it else seems impossible that this stream could have cut through such rocky masses by a gorge so narrow, and leaving so little sign of abrasion on the perpendicular cliffs" (p. 32). If there were really reason to regard this gap as the result of a convulsion of nature it would deserve to be carefully described; and such a rarity would become a mecca for geologists and geographers; but as there appears to be no sufficient ground for thinking it different in origin from the hundred other water gaps of the Appalachians, the people of Alabama ought to have a reasonable explanation of its method of production.

MASSANUTTEN MOUNTAIN, VIRGINIA.

A PRELIMINARY account of this peculiar sandstone mountain, rising from the limestone floor of Shenandoah Valley, is given by A. C. Spencer (Johns Hopkins Univ. Circ., No. 121, Oct., 1895, 13, 14). The mountain is of complicated synclinal structure, the resistent sandstone which forms its rim being bent into the form of a long, narrow, deep and wrinkled trough, whose bottom dips 1,000 feet or more beneath the surrounding valley floor. The greater part of the crest line of the mountain represents the much dissected Cretaceous peneplain of the Appalachian province; but certain points rise to greater elevations by as much as 500 or more feet. Passage creek, draining the northern portion of the valley enclosed by the mountain rim, is peculiar in cutting its outlet gap at the apex of the syncline, instead of to one side, as is commonly the case in Pennsylvania.

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CURRENT NOTES ON ANTHROPOLOGY.

ETHNOGRAPHIC SURVEYS.

IT has been already mentioned in these notes (see SCIENCE, Feb. 10, 1893,) that an ethnographic survey of Great Britain and Ireland had been instituted under the auspices of the British Association for the Advancement of Science. Already two preliminary reports have been made, and quite lately the Honorable Secretary of the Committee, Mr. E. Sidney Hartland, has published some explanatory notes about the plan, in the 'Transactions of the British and Gloucestershire Archæological Society.' These are very useful and suggestive, and together with the forms of schedule prepared by the Committee should be secured by students of ethnography as showing the well-matured methods of investigation decided upon by the high authorities in charge of the survey. They may be had by addressing 'the Secretary of the Ethnographic Survey, British Association, Burlington House, London, W.'

THE EARLY USE OF METALS IN EUROPE.

DR. JULIUS NAUE, the well known editor of the *Prähistorische Blätter* in Munich, contributes to the 'Revue Archæologique' an instructive article on the Hallstatt Epoch in Bavaria and the Palatinate, principally from his own researches.

His epoch is that of 'the first age of iron' and begins about 800 B. C. At its beginning bronze was much more abundant than iron, and the forms given it were graceful. The bodies were generally incinerated and placed in stone tombs. Long, leaf-shaped swords of iron were laid with the warriors, and ornamented vases of pottery beside them. Knives, daggers, pins, lance points and ornaments of both metals are common. The ethnographic conclusion is that these were Celtic tribes, probably the Licatii, of Latin authors. In agriculture they were skilled and in commerce had established distant relations.

Their contemporaries in the Upper Palatinate were less advanced, being addicted to human sacrifices and more warlike.

ANTHROPOMETRY OF THE AMERICAN INDIANS.

At a session of the Berlin Anthropological Society, in May last, Dr. Franz Boas reported the results of numerous measurements of American Indians and half-breeds, which he had carried out. A few of his conclusions may be mentioned.

On the whole, the Indian is rather tall, and the half-breeds slightly taller than the pure blood. The women are 92 to 94 per cent. the height of the male. As usual, the tallest tribes are dwellers in plains. The head-form varies extremely, but is persistent over wide regions, the Mississippi valley being peopled with mesocephalic tribes, the extreme north with dolichocephalic, while others, as the Téné, both north and south, are brachycephalic. There is no general type of native American skull. The facial diameter rarely sinks below 147 mm., and when such is the case foreign blood may be suspected.

The article is furnished with abundant tables and diagrams, and offers a fine example of scientific work.

THE MONUMENTS OF YUCATAN.

The first number of the anthropological series published by the Field Columbian Museum, Chicago, is the 'Archæological Studies among the Ancient Cities of Mexico,' by the curator, William H. Holmes. The first part, which alone has appeared, is devoted to the architectural remains of Yucatan. These were explored by the author in a visit there last winter, which included an inspection of the relics at Mugeres Island, Cozumel, Uxmal, Izamal, Chichen Itza, and some places of less note.

The results fill a volume of 137 pages, abundantly illustrated and rich with accurate observations and careful deductions. Several sketch maps and panoramas of the sites are inserted which give a much clearer notion than can be obtained from verbal descriptions. The analysis of the elements of Mayan architecture are especially original and valuable and impart a peculiar worth to this monograph. The same may be said of the observations on the materials employed, the orientation, the necessity for instruments of precision, the function of the buildings, the dressing of stone, the evolution of the ground plans, stairways and substructures, etc. In fact, the reader will find on almost every page something to catch his attention and to cast new light on the many obscure problems connected with the ancient Mayas.

D. G. Brinton,

SCIENTIFIC NOTES AND NEWS.

A PERMANENT SCIENTIFIC HEAD FOR THE U. S. DEPARTMENT OF AGRICULTURE.

An amendment to the Agricultural appropriation bill has just been sent to Congress providing for a "Director-in-Chief of scientific bureaus and investigations, to serve during good behavior, to have authority to act as Assistant Secretary, and to perform such other duties as the Secretary may direct."

This amendment, which has received the endorsement of the Secretary and Assistant Secretary of Agriculture, is the outgrowth of an effort to secure a permanent non-political organization and administration of the various bureaus and divisions engaged in the scientific work of the Government, and at the same time bring about a more intelligent and more effective coöperation than has been heretofore possible.

The chief promoters of this movement are well-known public-spirited educators and men of science entirely outside of the Government service.

The Department of Agriculture as at present organized comprises a large number of scientific and administrative divisions having for their object the discovery, exploration and development of the agricultural and other natural resources of the country. The scientific divisions are engaged in researches requiring the highest technical skill, and some of them in the solutions of problems requiring long years of preparation and scientific training.

Excluding the Weather Bureau, no less than eight divisions are doing work which in the main is purely scientific, and each of these has its independent laboratory or laboratories. Including the Weather Bureau and the meat inspection service of the Bureau of Animal Industry, 993 of a total of 2,019 employees are engaged chiefly upon scientific and technical subjects, and $1,700,000 of the $2,400,000 appropriated for the Department of Agriculture is expended upon this work. But the greater part of the work of the Weather Bureau and Bureau of Animal Industry, while fundamentally scientific in method and character, is not in the line of original investigation, and therefore may be omitted in the present statement. Still, each of these Bureaus conduct at Washington certain investigations in pure science, the cost of which, added to that of the eight scientific divisions already mentioned, amounts annually to nearly half a million dollars. Nevertheless no coöperative organization or classification of these scientific divisions, except those of the Weather Bureau, has been as yet undertaken.

It would seem a simple business proposition, needing no argument, that this comprehensive and vastly important work, promoting, as it does, the development of almost every resource of our land and every industry of our people, and concerning the food and health of a large part of our population, should have a permanent, broadly educated and experienced scientific head, free from the disquieting influence of politics.

The first, and in some respects the most difficult, step toward the accomplishment of this end was taken when Secretary Morton secured for the Department of Agriculture the protection of the Civil Service, thus putting an end to the terrors of political pressure in filling vacancies in the scientific divisions.

Should the amendment now before Congress become a law—and it is believed the friends of science and education throughout the land will give it their unqualified support—it is by no means improbable that other scientific bureaus of the Government will seek the protection and support provided thereby, and that in the near future we may boast a National Department of Agriculture and Science.

ASTRONOMY.

THE Lick Observatory has just published 'Contributions,' No. 5, a volume of 86 pages octavo, devoted to meteor and sunset phenomena. One of the most interesting papers in the volume is by Prof. Schaeberle, and contains a discussion of a series of meteor observations made simultaneously at Mount Hamilton and at Mount Diablo, forty miles distant. The Mount Hamilton observations were made by Messrs. Colton and Perrine; those at Mount Diablo by Mr. Schaeberle. The formulæ needed for the complete reduction of observations of this kind, including the criterion for determining whether the observations of both stations in any given instance really refer to the same meteor, are fully developed. Nine meteor paths were successfully worked out in this way in August, 1894. The heights of the meteors range from four to fifty-seven miles. Prof. Schaeberle concludes by pointing out that much more reliable methods of observation must be devised, if orbits having any approach to precision are to be secured for meteors. We can only hope that the experiments now in progress at the Yale College Observatory will lead to the possibility of observing these interesting bodies photographically.

WE learn from the last number of the Publications of the Astronomical Society of the Pacific that several important instruments have recently been completed at the works of Mr. Saegmuller in Washington. These include a nine-inch photographic instrument with collimators for the Observatory of Georgetown College, and a four-and-one-half-inch meridian circle for the Catholic University. Numerous other important instruments are in course of construction. We hope this new and very powerful photographic transit instrument will enable F. Hagen and F. Fargis to carry their very promising experiments in the direction of determining right ascensions photographically to a successful conclusion. If it shall prove possible to photograph the collimators with success, there can be little doubt that most important results will flow from the use of this new method.

MESSRS. MACMILLAN & CO. announce that Dr. G. W. Hill's 'Celestial Mechanics' will be published during the present year. The work will embody the lectures delivered at Columbia College by Dr. Hill, and will appear with the imprint of the Columbia University Press.

H. J.

HARVARD COLLEGE OBSERVATORY, CIRCULAR NO 5.

Wells' Algol Variable.

A MINIMUM of the Algol star, B. D.+17° 4367, occurred, as predicted in Circular No. 4, on the afternoon of January 5, 1896. Through the courtesy of Professor Young, observations were obtained at Princeton by Professor Taylor Reed, with the 23-inch equatorial. It was also observed by Mr. W. M. Reed at Andover. Preparations had been made at this observatory to obtain a series of photographic images of it automatically, each having an exposure of five minutes to observe it photometrically with the 15-inch equatorial, and also visually with the 12 and 6-inch equatorials. Unfortunately, owing to clouds, few observations were obtained, but these serve to show that the star was faint and diminishing in brightness as expected. Similar preparations were made for the next minimum, January 10, but again clouds prevented observation.

The observations so far obtained show that its time of minimum, uncorrected for the velocity of light, can be closely represented by the formula J. D. 2412002.500+4.8064 E. The uncertainty in the period does not exceed a few seconds, and will probably be known within a single second as soon as the form of light curve is determined. For nearly two hours before and after the minimum it is fainter than the twelfth magnitude. It is impossible, at present, to say how much fainter it becomes or whether it disappears entirely. It increases at first very rapidly and then more slowly, attaining its full brightness, magnitude 9.5, about five hours after the minimum. One hundred and thirty photographs indicate that during the four days between the successive minima it does not vary more than a few hundredths of a magnitude. The variation may be explained by assuming that the star revolves around a comparatively dark body and is totally eclipsed by it for two or three hours, the light at minimum, if any, being entirely that of the dark body. The conditions resemble those of U Cephei, which appears to be totally eclipsed by a relatively dark body two and a-half magnitudes fainter than itself, but having a diameter at least one half greater. The variation in light of B. D. +17° 4367 is more rapid than that of any other star hitherto discovered, and as its range is greater than that of any known star of the Algol type, its form of light curve can be determined with corresponding accuracy. U Cephei is second in both these respects.

The New Star in Centaurus.

In circular No. 4 insert 'it' before 'follows' in the ninth line. This word was given correctly in the printer's copy, but was omitted in setting the type. The correction was telegraphed to those astronomers who, it was expected, would use it. The Nova follows the nebula N. G. C. 5253, and is north of it. The nebula is assumed to be C. DM. —31° 10536, magn. 9.5, with which it was originally identified. As seen with a low power the nebula cannot readily be distinguished from a star. Its magnitude on the Cordoba scale by comparison with adjacent stars was estimated by Mr. Wendell as 9.7, and it could hardly have been overlooked in preparing the Cordoba Durchmusterung, in which many adjacent fainter stars are given. The new star could not have been observed at Cordoba unless we assume, first, that it was bright at that time, although invariably too faint to be photographed on fifty nights distributed over six years, and secondly, that the nebula was overlooked at Cordoba while observing fainter objects in the same region. Even if we make these assumptions, the new star still falls in the same class as T Coronæ, which was observed in the northern Durchmusterung several years preceding its appearance as a new star.

The various positions of N. G. C. 5253 for 1875 are as follows:—

Dreyer's New General Catalogue R. A. $=13^h\ 32^m\ 51^s$ Dec. $= -31°\ 0'.2$

Cordoba Durchmusterung R. A. $= 13^h\ 32^m\ 49^s.6$ Dec. $= -31°\ 0'.3$

Plate B 13965 R. A. $=13^h\ 32^m\ 50^s.2$ Dec. $= -31°\ 0'23''$

Plate B 14072 R. A. $= 13^h\ 32^m\ 50^s.0$ Dec. $= -31°\ 0'\ 21''$

The positions of the Nova derived from these plates differ from each other by only $0^s.1$ in right ascensions and $1''$ in declination. The mean position for 1875 is R. A. $= 13^h\ 32^m\ 51^s.8$ Dec. $= -30°\ 59'\ 58''$. It will be noticed that according to these measures, the Nova follows N. G. C. 5253 by $1^s.7$, and is $24''$ north.

EDWARD C. PICKERING.

JANUARY 31, 1896.

GENERAL.

MR. MORRILL'S bill in the Senate appropriating $250,000 for the erection of an additional building for the U. S. National Museum will be reported favorably by the Committee on Public Buildings and Grounds. The bill provides for a fire-proof building 300 feet square, having two stories and a basement.

THE daily papers contain much discussion regarding a dispatch purporting to come from Irkutsk, Siberia, and stating that Dr Nansen has reached the North Pole, has found land there and is now returning.

THE herbarium bequeathed by the late John H. Redfield to the Philadelphia Academy of Natural Sciences will be sold and the money used for a Redfield fund for the Botanical Department of the Academy.

M. ROUCHÉ has been elected on the second ballot, by 33 votes as compared with 29 cast for M. Lauth, *Membre libre* of the Paris Academy of Sciences. M. Moissan has been elected President of the Paris Chemical Society.

A BILL for the preservation of the Palisades, ceding to the United States jurisdiction over that part of the Palisades which lies in the State of New York, has been passed by the Legislature and will be signed by Gov. Morton.

THE Imperial German Health Bureau has reported that aluminum is especially suitable for cooking utensils, as it does not communicate any poisonous salts such as may arise from the use of copper, tin and lead.

A CABLEGRAM states that Prof. Röntgen was expected to conduct experiments on the X-rays before the German Reichstag, and that the Reichstag would be asked to make an appropriation for further researches. The daily papers continue to publish long accounts of experiments on the Röntgen rays, chiefly noticeable for their repetitions and inaccuracies. It is probable that no scientific advance has been made beyond what is contained in Prof. Röntgen's own paper published in the last number of this journal. It is, however, worth noting that Prof. Röntgen in his paper makes no mention of the possible applications of his discovery to surgery or elsewhere, but lays special weight on the speculation, having no apparent relation to his experiments, that the rays may be longitudinal vibrations in the ether.

Nature states that Mr. F. E. Willey, of the Royal Gardens, Kew, has been appointed Curator of the newly-founded Botanic Station at Sierra Leone. Mr. J. M. Henry has retired from the post of Superintendent of the Baroda State Gardens. He was sent out from Kew in 1867, and after twelve years' service in Madras and Bengal was appointed to Baroda in November, 1879.

THE Prussian Budget recommends the appropriation of $7,500 for the maintenance of a control station for diphtheria serum in connection with the Institute for Infectious Diseases.

THE Bender hygienic laboratory, now being constructed in Albany, will be completed during the present year and will contain every requisite of bacteriological investigations.

A CABLE dispatch states that a large aërolite exploded above the city of Madrid at 9:30 A. M. to-day. There was a vivid glare of light and a loud report. Buildings were shaken and many windows were shattered. According to the officials of the Madrid Observatory the explosion occurred twenty miles above the earth.

THERE is now a bill before the New York Assembly repealing the law compelling the schools to include the study of alcohol and narcotics in conjunction with the studies of physiology and hygiene. The Board of Education of the city of New York has voted to support this bill, and it has the support of the leading philanthropists and educators. The law passed last year by the Legislature of the State of New York and the similar laws in other States are regarded by those best competent to judge as injudicious and injurious to the cause of temperance.

EFFORTS are now being made to have the Legislature arrange for the permanent continuance of the geological study of the State of Maryland by providing for a State Geological Survey. Prof. William Bullock Clark will be placed in charge.

PROF. H. MARSHALL WARD, professor of botany in the University of Cambridge, is giving a course of three lectures on 'Some Aspects of Modern Botany' at the Royal Institution. The course began on February 13th.

A COPY of Audubon's *Birds of North America* is offered for sale in New York for $1,800. It is said to be unused and in the original binding, while a large part of the edition of 100 copies has had the margins of the plates reduced in size by rebinding.

WE learn from the *British Medical Journal* that fire broke out in one of the rooms of the Laboratory of the Edinburgh Royal College of Physicians on the night of January 31st, and resulted in disastrous consequences. The apparatus and specimens in one room were entirely destroyed by fire, and as these specimens had been brought together after the labor of years; the loss is irreparable. Several other rooms and their contents, including the chemical room, were seriously damaged by smoke and water. Had the fire not broken out in a room on the top flat and at an outside wall the results might have been vastly more serious. As it is, much has been destroyed that can never be replaced, even had insurances existed to the full. The work of the laboratory has been greatly disorganized, and some considerable time must elapse before the new buildings between Forrest Road and Bristo street are ready for occupation.

DR. BARNES has been elected the next President of the British Medical Association, which meets this year at Carlisle. Two addresses are to be given, one in Medicine by Sir Dyce Duckworth, and one in Surgery by Dr. Roderick Maclaren, and there are to be nine Sections, namely: Medicine, Surgery, Obstetrics, Public Health, Psychology, Pathology and Bacteriology, Ophthalmology, Diseases of Children, Medical Ethics.

PROF. BURDON SANDERSON has delivered a Friday evening lecture before the Royal Institution on Carl Ludwig and the mechanical physiology with which Ludwig's name is so closely identified. Prof. Sanderson said that the neo-vitalistic movement was already on the wane, and certainly that if any advance in knowledge is to be made the methods of research and reasoning adopted must be those of the Ludwig school.

THE Transactions of the American Microscopical Society, just published, contain a detailed account of the 18th annual meeting held at Cornell University last August, of which a report was given at the time in this journal. The next annual meeting of the Society will be held at Pittsburg, Pa., August 18, 19 and 20, 1896, under the presidency of Dr. A. Clifford Mercer, of Syracuse, New York.

HON. A. D. WHITE, formerly President of Cornell University, appeared on February 10th before the Senate Committee on a National University. He argued in favor of the plan, saying that in this respect the United Stated government is behind the European states. He contended that instead of weakening other universities, as had been claimed, the establishment of a National institution would strengthen all other seats of learning. It is expected that the committee will report favorably.

DR. DANIEL DENISON SLADE, lecturer on comparative osteology in Harvard University, and known for his contributions to osteology, zoölogy and botany, died at Chestnut Hill, Mass., on February 11th, aged 71 years.

MR. G. B. HOWES announces in *Nature* for January 23d, the discovery by Mr. J. P. Hill that the Bandicoot, *Perameles obesula*, possesses a true allantoic and highly vascular placenta of a discordal and most probably deciduous type. This, taken in connection with what is known to occur in *Phascolaretus*, weakens the line of demarcation between the marsupials and other mammals, or rather causes a slight overlapping of the two groups.

THE contents of the last issue of the *Bulletin of the Johns Hopkins Hospital* are very different from what most people would expect to find in a medical journal. There are three papers read by Prof. William Osler and one read by Mr. W.

B. Platt before the historical club of the hospital, and the address of Prof. W. H. Welch at the opening of the William Pepper laboratory of clinical medicine. The papers are all noteworthy for historical research and literary form. Prof. Osler reviews the life of Thomas Dover, physician and buccaneer, whose career throws curious light on the social conditions and medical practice in England at the beginning of the eighteenth century. In a second paper there is given from private sources an account of the life of an Alabama student, John I. Basset, "whose name was not written on the scroll of fame, but who heard the call and forsook all and followed his ideal." Prof. Osler's third paper is entitled 'John Keats, the Apothecary Poet.' Mr. Platt reviews the work of Johannes Müller as a physiologist and a teacher. Prof. Welch, in his address at Philadelphia, described the evolution of modern scientific laboratories. With the exception of anatomy, laboratories for instruction and research are comparatively recent. Purkinje's physiological laboratory at Breslau was established in 1824, one year earlier than Liebig's famous chemical laboratory at Giessen. Lord Kelvin established a physical laboratory in Glasgow about 1845. The first pathological laboratory was founded by Virschow, in Berlin, in 1856.

THE Division of Botany of the U. S. Department of Agriculture has issued a bulletin by Mr. L. H. Dewey reviewing the legislation undertaken by twenty-five of the States and Territories for the suppression of weeds and giving the essential provisions of a general State weed law.

THE Canadian government proposes to send an expedition to Hudson's Bay next summer to establish customs officers and to further investigate the navigability of Hudson's Straits.

THE position of scientific adviser to the London Trinity House, which has been in abeyance since the resignation of Tyndall, has been revived and has been accepted by Lord Rayleigh.

THE Royal Academy of Sciences of Belgium proposes, as the subject for a prize in 1897, a discussion from a theoretical point of view of the Variation of Latitude, its cause and meaning, together with a criticism of the works of geometers on the subject, from Laplace to the present time. A gold medal valued at 800 fr. will be awarded.

THE *London Times* states that investigations have recently been undertaken by the Marine Biological Association into the contents of certain bays on the south coast of Devon. The bays selected for the investigations were Start and Teignmouth Bays, both of which are closed to trawlers in accordance with a by-law of the Devon Sea Fisheries Committee. The object in view of which the work was begun was to discover the characteristic features of the localities in question in respect to the food fish they contained. Mr. F. B. Stead, the naturalist in charge of these investigations, has conducted trawling experiments in these localities during the months of October to December, and the most important facts ascertained by him are as follows: Of the different species of fish captured in the bays, plaice and dabs are by far the most numerous, and as of these two species the plaice is, from the economic point of view, far the most important, and the large number of competing dabs must probably be regarded as a positive hindrance to the well-being of the plaice, any controversy that may be raised as to the advisibility or otherwise of maintaining the by-law now in force should be solely occupied with the consideration of the question whether the closure of the bays to trawlers is necessary or desirable for the protection of the plaice. It has been further shown that the bays differ markedly from one another in respect to the sizes of the fish they contain. Thus, while half the plaice in Start Bay were found to be over 12½ in. in length, in Teignmouth Bay half the plaice captured were under 10½ in. A similar difference held in the case of the dabs. A preliminary account of these investigations will appear in the ensuing number of the journal of the Association.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. D. G. ORMSBY, of Milwaukee, has given $25,000 to Lawrence University at Appleton, Wis., to endow the 'D. G. Ormsby professorship of history and political economy,' in memory of the husband; and by the will of the late Horatio Stone, Rockford College, Rockford, Ill., receives $28,000. Donations to the University of Pennsylvania during the past month amount to $69,370.23.

AT the meeting of the Board of Trustees of Princeton College, held on February 13th, Mr. J. Bayard Henry, '77, of Philadelphia, was elected trustee in place of William Libbey, of New York City, deceased, and Mr. Howard Crosby Warren, '89, was appointed assistant professor in experimental psychology.

ON the birthday of Mr. Henry W. Sage, celebrated at Cornell University on January 30, the following list of his gifts to the University was noted:

Sage College for women, with endowment fund (1873)	$266,000
Sage Chapel (1873)	30,000
Contribution towards extinguishment of a floating debt (1881)	30,000
House of Sage professor of philosophy (1886)	11,000
Susan Linn Sage chair of philosophy (1886)	50,000
Susan Linn school of philosophy (1886)	200,000
University library building (1891)	260,000
University library endowment (1891)	300,000
Casts for archæological museum (1891)	8,000
	$1,155,000

A MEMORIAL praying for the admission of women to degrees at Cambridge University has received the signatures of 2,200 university members.

DR. CESARE LOMBROSO has been transferred from the chair of legal medicine in the University of Turin, to the post of professor of psychiatry. He has also been made director of the University Clinic for Mental Diseases.

WILLIAM WARDE FOWLER, M.A., Fellow of Lincoln College, Oxford, has been appointed a Curator of the Botanic Garden, in place of Edward Chapman, M.A., Fellow of Magdalen College, resigned.

CORRESPONDENCE.

AMERICAN JUDGMENTS OF AMERICAN ASTRONOMY.

THE astronomical notes published in the last two numbers of SCIENCE afford instructive illustrations of a habit of judging American and foreign scientific work which is too prevalent among us. While in nearly every other country scientific investigators and writers are apt to be more or less biased in favor of their own countrymen, giving frequent occasion for remarks on their ignorance of what is going on outside and on their general insularity, the system prevalent among us is directly the contrary, at least in astronomy, and, to a certain extent, in the allied sciences. The way in which this bias displays itself is so well illustrated by the notes in question that we may be pardoned for taking them as a text for some remarks.

Among the great wants of astronomy for half a century past has been a standard system of positions of the principal fixed stars, which should serve as points of reference in defining the positions of other stars and of the heavenly bodies in general. The first step toward this end was taken by Dr. Auwers about 1870, and consisted of a determination of the corrections necessary to reduce the principal modern catalogues of stars to a homogeneous mean system; that is to say, to a system which should be as nearly as possible self-consistent, and express the mean result of all the determinations of positions made in each region of the heavens. But this work, though most ably performed and marking an epoch in astronomy of precision, was defective in not rigorously taking account of the proper motions of the stars. Hence, Dr. Auwer's system was valid only near a central epoch, say about 1840 or 1850. That he did not make it permanently valid was doubtless due to the fact that at that time the older observations, especially those of Bradley, had not been reduced with sufficient rigor to determine the proper motions. It was, therefore, a fitting complement of his work that he set about the thorough re-reduction of Bradley's observations at Greenwich with the mural quadrant, during the years 1750-1757.

About 1878 was published Boss's system of declinations, which appeared in a quarto volume of some 200 pages. A careful examination of this work showed that it stood unequalled in the thoroughness with which all the material was collected and worked up; in the completeness with which the errors of the older adopted values of the astronomical constants were corrected, and in the rigor with which the entire discussion was carried through and the results presented.

A year or two after the appearance of Boss's work, the new system for the *Astronomische Gesellschaft*, constructed by Dr. Auwers, was published. A very slight examination of this work would show that its superiority to that of Boss was at least open to question. The weakest point was that the proper motions depended entirely on the observations of Bradley with the old mural quadrant, which was known to be subject to errors the amount of which did not admit of determination. But this defect did not prevent the general adoption of the foreign system by American astronomers, even in the case where the other would have been most eminently appropriate, the official work of boundary surveys.

There is one final and conclusive arbiter of all questions concerning the accuracy of predicted motions in the heavens. This arbiter is subsequent observation. Let us wait a sufficient length of time and see on which system the positions of the stars are most accurately predicted. In certain features of the system and in certain regions of the heavens the two works differed so widely that a very few years of accurate observations would suffice to settle the question.

About twenty years have elapsed since the last observations on which either of the two works was based. Within that time four catalogues of stars have appeared, founded on observations made at the respective observatories of Pulkowa and Greenwich, prepared with all the refinements of recent science, and therefore superior to any before made. In these results, combined with such conclusions as can be drawn from the best previous observations, we have the basis of a comparison which is found in the number of the *Astronomical Journal* quoted in the note found in the last number of SCIENCE. Without going into technical details, it will suffice to say that there are six separate and independent features in which the respective systems differed most largely. These six features, tested by the four modern authorities just quoted, showed the following average errors or difference between Boss's prediction and observations in different regions of the heavens, near the epoch of 1880:

—0″.02	+0.02
—0.03	+0.02
+0.03	0.00

It was then shown that, carrying back these six special points of difference between the two catalogues to the epoch of Bradley's observations, the actual differences between the two were larger than any likely deviation of Boss from the truth. In the most marked case the difference consisted in ten discrepancies, all in the same direction. Another very marked instance occurs in a region of the heavens including the northern part of the constellation Andromeda. In this region were found ten stars in the A. G. catalogue. The Polkowa catalogue of 1895, the most carefully prepared that astronomy has yet had at its command, showed that every one of these ten stars was in error in the same direction, that direction being the same in which they differed from the Boss system, and by amounts which could not be reasonably attributed to errors of the Pulkowa observations.

One would suppose the conclusion so obvious as to need no statement and admit of no question. Fifteen years of the most refined observations show a continuing agreement of the Boss system with observations which is most extraordinary, and which cannot possibly be shared by the other. This evidence, however, fails to convince the writer of the note. He claims that the results 'throw no new light on the subject.' If astronomers differ as to the question whether the approach to perfect agreement with observation above shown is conclusive, the question would seem to be forever incapable of decision.

Again, in the case of ten separate stars in which the deviations of the Bradley observations were all in the same direction, the writer remarks: "So we can hardly escape the conviction that our whole conclusion may be vitiated by a large error in a particular star."

Here it would seem that the astronomers must have recourse to legal advice to settle their dispute. Only a member of the legal profession can decide whether the concurrent evidence of ten independent witnesses, all testifying to the same fact, may be 'vitiated' by one of them being very much mistaken. It is to be regretted that the writer of the note does not tell us just how far the one erroneous star must have been wrong in order to vitiate the result. The corresponding testimony of the ten Pulkowa observations upon another group of ten stars may be left out of consideration, because this conclusion might be vitiated in the same way. S. NEWCOMB.

THE PERTURBATIONS OF 70 OPHIUCHI.

PROF. JACOBY'S review in a recent number of this journal (p. 197) is eminently fair in spirit; it is incomplete, and therefore I fear it will be misleading. It is a mistake to say that my work on the perturbations of 70 Ophiuchi is supported by the American observations, but contradicted by those made at the same time in Europe. On the contrary, the deviation from Schur's orbit and the work of the American observers is confirmed by the measures of all the best observers abroad. Thus the deviation appears unmistakably in the observations of Bigourdan, Callandreau, Schiaparelli, Glasenapp and Knorre. Since publishing the paper in *American Journal* 363, measures have been received from several of the above observers, and there is absolutely no doubt of the substantial accuracy of the American observations. Among the European observers Schur and Ebell (a student at Berlin) alone find no deviation, but Schur's measures are very discordant, and he admits (A. N. 3324) that they are of little value; while Ebell's measures show discrepancies on the several nights amounting to over ten degrees in angle.

Hence it is evident that all the best observations, both American and European, confirm the deviation from Schur's orbit and point to the existence of the dark body as the cause of this unexpected phenomenon. My researches on the orbits of 40 binary stars, which are now practically complete, will probably remove all doubt as to the propriety of using the distances in such investigations. Indeed the discovery of the perturbations in 70 Ophiuchi by using both angles and distances, after Schur had consciously rejected the distances which would have given him the discovery, is a striking illustration of the evil of orthodoxy in scientific procedure. T. J. J. SEE.

THE UNIVERSITY OF CHICAGO, February 11, 1896.

PSYCHOLOGY OF NUMBER.

TO THE EDITOR OF SCIENCE—*Sir:* As Prof. Fine in his review of McLellan's and Dewey's *Psychology of Number* (January 24, 1896) raised a question of considerable importance to educators and to psychologists, permit me to add a few words to the discussion, first thanking the reviewer for the generally appreciative tone of his article.

1. The question of principle raised is whether or no counting is measuring, whether or no integral number has a metric origin or purpose, and involves the idea of ratio. Now measurement is a word both of a more general and a more technical sense. That, in the most technical mathematical sense, counting is not measurement, is clearly recognized in the book referred to. But as it is held that in the larger sense of the term it is a process of measuring, and that the technical mode of measurement is an outgrowth, psychologically, of the broader and looser sense, this disclaimer amounts, perhaps, to little.

Starting from the larger sense, it is held that number has its psychological genesis in the felt need for valuation, and that its function (psychologically once more) is to serve the purposes of valuation. Now counting seems to me indubitably one mode of defining the value of a previously unvalued mental whole, and in that sense to be a mode of measurement. Any process of defining value is, I should say, a form of measurement in the broad sense of that term. Counting implies first a mental whole; secondly, the breaking up of that whole into distinct parts; third, the use of one (any one, not some one) of these parts as a unit; fourth, the measurement of the amount or value of the original whole, through equalizing it to a certain definite number of the selected unit.

But Prof. Fine says: "In however loose a sense the word may be used, 'measuring' at least involves the conscious use of a unit of reference. But no one ever did or ever will count a group of horses, for instance, by first conceiving of an artificial * unit horse and then matching it with each actual horse in turn—which 'measuring' the group of horses must mean if it means anything."

The whole point here is under what circumstances does one, not a mathematician or for mathematical purposes, count a group of horses. The answer is something of the following sort, it seems to me: One counts when one wishes to find out how many horses he has caught in a day's hunt, whether the same number has been driven back at night that were taken out in the morning; how much money is to be got in selling them, it having been settled that each horse is to fetch the same sum, etc., etc.; how one ranks as a chieftain, or a soldier, compared with others, etc., etc. In other words, one not having arrived at the *abstract* interest of the mathematician (and certainly the child to be educated has not) counts only *when* there is some value to be ascertained, and counts *by* setting off something which, for present purposes is a sample unit of value, *e. g.*, a horse, then equating the total value to the number of such units. Taking the matter in its development then, (and not at the stage of the mathematician when abstracts have already become concretes) enumeration is always to define value, *i. e.*, to measure.

If the book referred to did not recognize the distinction between this sort of measuring and the technical sort it should certainly be condemned. But one of the points emphasized is that the former is an imperfect sort of measurement; that we don't really know, *e. g.*, what the possession of 60 horses amounts to till we know what one horse is worth, and so measuring proper (measuring with measured units) is substituted for mere counting, *i. e.*, measuring with undefined units of value.

2. It is said that number is not ratio. If one is using ratio to denote a certain idea, and not a technical abstraction of the mathematicians, I do not see how this statement is to be reconciled with Prof. Fine's own account of enumeration: "'To count a group of things on the fingers is merely by assigning one of the fingers to each one of the things to form a group of fingers which stand in a *relation of 'one-to-one correspondence to the group of things.'*" * And again, "When we say of two groups of things that they are equal numerically, we simply mean that for each in the second there is one in the first, and for each thing in the first there is one in the second, in other words that the groups may be brought into a *relation of one-to-one correspondence.*" What does the phrase italicized mean, save the idea of ratio? If this way of stating it had only been known to me when the book reviewed was written, I should gladly have utilized it to indicate precisely the point we were trying to make—the implicit presence of the ratio idea in every number.

Psychologically there is, of course, a difference in the mental attitude in recognizing a thing as 'one,' as unity, as a whole, an individual, and recognizing it as '*a* one,' a unit. The primary problem the educator has to face, if he is to rationalize the teaching of arithmetic, is the discovery of this difference. The answer given is that 'one' (qualitative individuality or unity) becomes '*a* one,' a unit when it is *used* to *measure* value; and that, in turn, the need for this use arises when the thing is no longer taken as an adequate end, but as a means to be adjusted to some further end. *E. g.*, once more, when a man is *wholly* occupied in riding or hunting, or feeding a horse, when that absorbs his whole interest, he never takes the numerical view; when he wants to know how much of a horse owner he is, and how far this horse contributes to that end, he necessarily takes it. The question then is whether 'one' ever becomes '*a* one,' save as it is put into a 'relation of one-to-one correspondence?'

3. Prof. Fine remarks that 'the one postulate of arithmetic is that distinct things exist.' The mathematician may perhaps be reminded that this postulate is precisely one of the chief problems of the psychologist. Given a certain num-

* Whence and wherefore this artificial? The point to be proved involves nothing about an 'artificial' unit, but only a unit of reference, and that surely a horse is. But even if the term were relevant in the argument the question would arise whether the use of an artificial unit or of a measured unit is the essence of technical measurement; whether, indeed, a foot is, psychologically, more artificial than a horse.

* Italics mine.

ber of things already recognized as distinct, and it is a very simple matter to go ahead and enumerate them, though even that must have a psychology *motivation.* But the whole tendency of contemporary psychology is to take a psychical continuum as its datum, and find distinctness (the property at the basis of number) as the outcome of a process of differentiation. The identification of this process, the ascertaining of the circumstances under which it arises, the mode of its operation—this is the thing which the psychologist wants to know about number, and is the thing the educator must know to secure the conditions under which the child shall form the number concepts easily and efficiently. The theory of the book, 'Psychology of Number,' viz., that the differentiation and enumeration of units arises through the progressively accurate adjustment of means to end, may be right or wrong, but its error can hardly be established, I take it, by a mathematical view which considers number only as it is after it is fully developed, and has become so familiar as to be itself a complete object to the mind. Without pretending to a knowledge of numerical theory which I do not possess, I may say that it seems to me that the work done by Gauss is at precisely the opposite pole from that which the educator needs from the psychologist, *i. e.*, Gauss was attempting to reduce to its ultimate simple numerical generalizations the developed mathematical structure. Dr. McLellan and myself were engaged upon the much humbler task of finding out what sort of a mental condition creates a demand for number, and how it is that number operates to satisfy that demand.

May I conclude by referring to the practical point involved? The trained mathematician as such is, of necessity, interested in the further use of certain finished psychical products. As a mathematician any reference to the preliminary development of these products can only disturb and divert him. But the problem for the pupil *is how to get the standpoint of the mathematician;* not how to use certain tools, but how to make them; not how to carry further the manipulation of certain data, but how to get meaning into the data. This is ultimately a psychological question, not a mathematical one, although it has to be translated over into mathematical terms and processes; and none is so well fitted to do it as the mathematician, provided only he will project himself far enough backward in the scale of development to realize the problem. The point does not conclude with primary instruction. Our text-books of algebra, geometry and high analysis are almost entirely written from the standpoint of an elegant and logical exposition of the matter as it stands to the trained mathematician. They are very nice for one who doesn't need them any longer. The first books written from the standpoint of one who is still coming to consciousness of the meaning of his concepts will, perhaps, seem foolishness to the trained mathematician, but they will mark the dawn of a new day to the average student. I venture the statement that (putting aside the few with the inborn mathematical instinct) higher and secondary mathematics is to the majority of students a practical riddle with no definite *intellectual* content in itself. What meaning it possesses it has got by way of attained practical facility in solving problems; or through its applications to other sciences or to engineering. It will hardly be denied that the educational value of mathematics is not realized until its concepts and methods have a definite intellectual meaning and content of their own. Can this be secured, save as the methods of instruction follow the evolution of the process out of its cruder psychical forms to the more finished?

I shall be more than satisfied to have made many blunders on the mathematical side if only I do not offer myself up in vain as a spectacle; if only more competent psychologists take up the matter, and if only mathematicians may descend from their acquired mathematical plane and endeavor to rethink the psychical conditions and steps through which their present magnificent apparatus has grown out of primitive, non-mathematical or crudely mathematical forms up to its present high estate. If the psychologist will risk some blundering around among the mathematical concepts, and the mathematician will recognize the relevancy of the psychological demand, and venture a little blundering upon that side, both parties may not only come to an understanding, but mathematical teaching may get what it to-day so largely lacks, some relationship to the psychical needs and attitudes of those under instruction.

JOHN DEWEY.

UNIVERSITY OF CHICAGO, February 6, 1896.

DOES THE PRIVATE COLLECTOR MAKE THE BEST MUSEUM ADMINISTRATOR?

THE concluding portion, section K, of Dr. Goode's recent paper on the Classification of Museums, is devoted to a consideration of private cabinets and collectors, and to the major portion of the propositions therein laid down all can heartily subscribe. There is, however, one among them to which I can not fully assent, at least so far as museums of natural history are concerned, and that is, that "The person who has formed a private collection can most successfully manage one for the use of the public."

It must be confessed that this doubt largely rests upon theory, but an acquaintance with some collectors makes it seem probable that it is, after all, well founded.

A considerable amount of collecting is done with no purpose in view other than that of accumulating specimens, but, on the other hand, a private collection may be formed with a definite purpose and along certain lines. In the one case the collector certainly shows no unusual fitness for a position in a museum, while in the other he is interested in his collection for what he can get out of it himself and not for the benefit it may be to others, and this is exactly the opposite view to that which should be held by an officer in a public museum. This is not saying that such is the point of view universally assumed by museum curators, but it is certain that the success of a public museum depends on the extent to which it is adopted. Again a private collector is, from the nature of the case, apt to be one-sided, to lay too much stress on one group to the exclusion of others, and thus to lack the evenness of balance which should be one of the characteristics of the 'museum man.' This one-sidedness frequently takes the form of undue preference for rare or costly specimens, attaching an undue importance to the specimens themselves rather than what is to be got out of them.

Moreover the care and arrangement of a private study series and of a public study series, and, above all of an exhibition series, are entirely different things and require a totally different treatment. A private series may be ill-arranged and poorly labeled, but the owner knows each specimen, its history and whereabouts. A public study series should, on the contrary, be so arranged and so labeled that any student may consult it and make notes upon it, while in an exhibition series the specimens should be so chosen that, while each conveys some information, all form a harmonious whole.

A private collector may know his own needs, but he would not know or would not care for the needs of the public, and he would carry to a public museum the taste for accumulation, or for research, which probably led to the formation of his own collection. Accumulation is a good thing, but it needs to be properly directed in order to be of public service, while there is probably no greater drawback to the public efficiency of a museum officer than too great devotion to original research, as this leads not only to lack of care for material which has served its turn, but to a very decided lack of interest in the public which must be reached through the exhibition series.

This criticism is by no means to be construed into a criticism of the private collector; the value of his work and the influence of his collections are immense; it is simply a denial of the proposition that because a man has formed a private cabinet he is therefore best fitted to administer a public museum.

F. A. LUCAS.

WASHINGTON, D. C.

SCIENTIFIC LITERATURE.

Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere. OSCAR HERTWIG. Jena, Gustav Fischer. 1895. Pp. xvi + 612.

This excellent work now appears in a fifth edition, in which many improvements have been made. Prof. Hertwig is especially distinguished both for his comprehension of the problems of morphology and for the lucidity of his explanations, so that his text-book has long been accepted as a valuable treatise both for students and for advanced workers, and has been accorded the distinction of translation into several languages. A very admirable translation into English has been published by Prof. Mark, based upon the third German edition. The book has already an assured and high place, and is so well known that it is only necessary to state that its typography and general appearance have remained unchanged.

In the new edition many much needed improvements have been made, and several parts have been entirely recast to concord with the latest progress. The revision has touched especially the following parts: the problem of reduction-division; the rôle of the centrosome in impregnation, the development of the middle germ layer in reptiles and mammals, the structure of the chorion, the origin of striated muscles, of blood corpuscles and the development of the vesicula; and there is one entirely new section, which will be welcome to many embryologists and bears the title, 'Experiments and theories on the significance of the first-formed cleavage cells and of single parts of the ovum for the formation of the organs of the embryo.' There have been so many researches in this field, and they bear so directly on Weismann's and other theories of heredity, that the synopsis given by Hertwig will appeal both to those actively at work in this comparatively new region of embryo-mechanics, and to those who wish to learn what conclusions have been reached up to the present. We may also note that since the first edition the number of illustrations has risen from 304 to 384, and the number of pages from 507 to 612.

There are certain general criticisms to be made upon Hertwigs' text-book. It is certainly a defect that the author leans far too much upon both diagrammatic pictures and upon diagrammatic explanations, and does not allow free play to actual observation. This is disastrously the case in his sixth chapter in which he deals with the origin of the middle germ-layer (cœlom theory), and by artful shading misrepresents the actual facts in a manner which is inexcusable even in a text-book. Facts ought never to be mixed with error merely because such dilution serves to hide their discordance with the author's theoretical views. The same tendency to uphold his cœlom theory shows itself in another way in that he still entirely separates the mesenchymal tissues and the mesothelial (to which latter he erroneously restricts the term mesoblast, p. 115), although it was proven several years ago so as to be past doubt, that Hertwig's view was unjustified and that mesenchyma and mesothelium are parts of the same layer or mesoderm. This result is not a matter of opinion, it is simply a matter of direct observation. This conclusion Hertwig has admitted, yet fails to make it the basis of his exposition, and instead continues the unnatural separation of the two portions of the middle germ layer, much to the confusion of young students.

Other unfavorable criticisms may be made in regard to special parts of the subject treated inadequately. Such parts are: 1. The nervous system, in that he fails to bring out the fundamental division into dorsal and ventral zones, or the existence of the three primary layers of the medullary wall, or the significance of the neck-bend, or the history of the neuromeres. 2. The fact that the nails are modifications of the stratum lucidum of the epidermis, a very important morphological fact. 3. The development of smooth muscle. 4. The history of the group of connective tissues. 5. The account of the formation of the renal tubules is erroneous, and is the most serious defect noticed by the reviewer. 6. The origin and significance of the yolk cavity and its fusion with that of the notochordal canal in Anura and Amniota to form the definite entodermal canal is not discussed, yet it is a very important point in the morphology of the higher vertebrate embryos. These and other examples which might be given show that Hertwig is far from giving a well-rounded presentation of our present knowledge, and that very much needs to be added to make it a thorough and comprehensive treatise.

In spite of these limitations, Hertwig's Embryology is a text-book of the first class, and has done and will probably long continue to do much for the promotion of the branch of science with which it deals. The treatment of the subject is fresh, original, strong and well proportioned, so that the leading points receive due emphasis. In many parts Hertwig speaks with the highest authority, notably in regard to the earlier stages of development, and the history of the genital products. The illustrations are admirably selected and well executed, except for their tendency toward schematization. The original figures are not numerous and are chiefly diagrams.

In conclusion, it may be said that any student who, with the aid of practical laboratory work, masters Hertwig's book will have mastered the general subject of human embryology from the comparative morphological standpoint, and will be qualified to pursue more advanced study, but he must remain ready to modify many of his general theories and to fill out a number of important gaps in his knowledge. His chief gain will be insight into the very spirit of morphology, through the guidance of one of the very ablest of morphologists.

C. S. MINOT.

A Handbook of the British Macro-Lepidoptera. By BERTRAM GEO. RYE. With hand-colored illustrations by MAUD HORMAN-FISHER. London, Ward & Foxlow. Parts 1–4, Jan.–Oct., 1895.

The four parts issued give a fair idea of the scope and execution of this addition to the already large number of works relating to the butterflies and moths of Great Britain. Each part contains eight pages and two plates.

In the introduction the changes that take place during metamorphosis and the principal characters used in classification are briefly described. Eight families of Rhopalocera are recognized, namely, Papilionidæ, Pieridæ, Nymphalidæ, Apaturidæ, Satyridæ, Lycænidæ, Erycinidæ and Hesperidæ. A table separating these is given, and the genera and species can be readily distinguished by means of similar tables. The species are fairly well described, and the notes on the early stages, haunts, times of appearance, and abundance are clear and concise.

The plates are excellent, and the distinctive value of Mr. Rye's work consists in the description and illustration of the varieties and local races, apart from the consideration of the species, of the Macro-Lepidoptera of Great Britain. Beginning with 1896 the parts will be issued bi-monthly, instead of quarterly. The price per part is 2s. 6d.

SAMUEL HENSHAW.

Mollusca and Crustacea of the Miocene Formations of New Jersey. By R. P. WHITFIELD. Monograph U. S. Geol. Survey. Vol. XXIV. 1894.

This latest contribution of Professor Whitfield to the paleontology of New Jersey is most opportune, since the detailed mapping of the coastal plain formations of the State has recently shown an extensive development of Miocene strata. The character of the deposits is such, however, that determinable fossils have only been detected at a very few points, the great majority coming from the marl beds in the vicinity of Shiloh and Jericho and from the deep well-borings at Atlantic City. These forms Prof. Whitfield has evidently studied with great care and has presented in a most acceptable manner.

Prior to the publication of this report by Prof. Whitfield, little systematic work had been done upon the fossils of the Miocene of New Jersey. Meek's list, published in the 'Smithsonian Miscellaneous Collections' in 1864, contains reference to only seventeen species. Prof. Heilprin in his 'Tertiary Geology of the eastern and southern United States,' published in 1884, gives twenty-seven species, seventeen of which he regards as peculiar to the State. Later, from time to time, the same author added to this list, until in 1887, in an article on 'The Miocene Mollusca of the State of New Jersey,' he enumerates eighty-two species, describing three new species and one variety.

In his monograph Prof. Whitfield recognizes one hundred and four species, but states that there is no doubt that many more species might be obtained were the beds more thoroughly examined and other localities explored. Of the species described thirty-six are regarded as peculiar to New Jersey.

Besides the molluscan remains enumerated, Mr. Anthony Woodward gives a list of twelve species of foraminifera found in the marls at Shiloh and two at Jericho.

Prof. Whitfield, from a study of the fossils, would correlate the deposits with the Miocene of the States to the south, which is fully substantiated upon physical grounds as well. The writer of this review has traced the strata across Delaware into Maryland so that there can be no doubt but that the New Jersey Miocene is the direct continuation northward of the Chesapeake formation of the Middle Atlantic slope.

W. B. CLARK.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON, FEBRUARY 1.

MR. LESTER F. WARD read a paper on 'The Filiation of the Sciences.' The purpose of the paper was to trace the progress of the conception of a natural order of development for the larger groups of phenomena, as distinguished, on the one hand, from any attempt at a logical classification of the sciences, and on the other, from the consideration of the order in which the sciences have been historically developed. Without going back of the present century to deal with the more or less fanciful notions of the Ancients or of such moderns as Oken, Hegel, d'Alembert, Hobbes, Locke, etc., he drew attention to the views of Auguste Comte and Herbert Spencer, as the two philosophers who had clearly conceived the problem of natural evolution.

He first traced the development of the idea in the mind of the first of these writers from 1820 to 1842. In a paper published by him in 1820, he had quite clearly expressed the fundamental truth, and arranged the great groups of phenomena, or sciences, in the following order: 1, Mathematics; 2, Astronomy; 3, Physics; 4, Chemistry; 5, Physiology; giving to each of these terms a wide meaning, but admitting that mathematics was not coördinate with the others, but was only the criterion by which each of the others was to be judged and its position in the series fixed. From 1826 to 1829 he elaborated this scheme in a course of lectures, soon after published as his well-known work on Positive Philosophy, the first volume of which appeared in 1830. In the prospectus of these lectures, circulated in manuscript form in 1826, he added to the above five sciences a sixth, viz., Social Physics, and the scheme as then drawn up was introduced in tabular form at the beginning of the first volume of the Positive Philosophy. In Vol. III. of that work, which appeared in 1838, he substituted for his 'Physiology' Lamarck's term Biology, but the scope of this science was the same as before and practically that of biology as now understood. The last chapter of that volume was devoted to what he called the intellectual and moral, or cerebral, functions of life, in which he fully recognized the present science of psychology, but denied that it could be properly separated from biology. In the fourth volume, published in 1839, he speaks of this as 'Transcendental Biology.' It is in this volume, too, that he first proposed the term 'Sociology,' as the exact equivalent of his 'Social Physics,' and continued to the end to use both these terms interchangeably. It was not till 1842, with the appearance of the first volume of his Positive Polity (*Politique Positive*), that he added anything to the scheme of sciences thus drawn up. He then recognized, as the seventh and last term of the series, the science of Ethics. The entire series, then, as he finally left it, was as follows: 1, Mathematics; 2, Astronomy; 3, Physics; 4, Chemistry; 5, Biology (including cerebral or transcendental biology); 6, Sociology; 7, Ethics.

Comte was at great pains to explain that this series represented the true order of nature, and that the phenomena corresponded to the actual evolution that has taken place in the universe. The degree of 'positivity' of any science is that to which it can be reduced to mathematical laws. The first of the sciences that represent phenomena, viz., astronomy (from which sidereal astronomy was excluded) is therefore the most positive, and the degree of positivity diminishes with each term in the series. The sciences thus arranged also diminish in their generality while they increase in their complexity.

Moreover, each higher science has its roots in the one next below it and is, as it were, derived from it. The relationship is genetic, and hence his favorite term 'filiation,' a word much better chosen than the term 'hierarchy' which he also applied to the system.

Mr. Ward next proceeded to consider the scheme of Mr. Herbert Spencer as elaborated in his Synthetic Philosophy. A prospectus of that work was circulated in 1860. It was to embrace one volume on First Principles, two volumes on the Principles of Biology, two volumes on the Principles of Psychology, three volumes on the Principles of Sociology, and two volumes on the Principles of Morality. In this prospectus, between the First Principles and the Principles of Biology, was inserted the following explanatory note: "In logical order should here come the application of these First Principles to Inorganic Nature. But this great division it is proposed to pass over, partly because even without it the scheme is too extensive, and partly because the interpretation of Organic Nature after the proposed method is of more immediate importance." This scheme of course was regarded by all as representing Mr. Spencer's conception of the natural order of evolution in the universe, and the arrangement of his topics was supposed to reflect his views of the actual succession of cosmic events. The groups of phenomena, *i. e.*, the several great sciences, would, therefore, stand as follows:

1. Inorganic Nature (subdivisions not indicated); 2. Biology; 3. Psychology; 4. Sociology; 5. Morality. How closely he has adhered to this scheme is known to all, the only deviation being the merely verbal one of substituting the word Ethics for 'Morality' in the title of the last work.

How he would have subdivided the phenomena of inorganic nature, and how he would have designated and arranged the subdivisions, has remained for the most part a matter of inference. In illustrating the cosmical laws laid down in his First Principles he frequently swept across the whole field and generally began with the nebular hypothesis and astronomical phenomena, then dealt with planetary and terrestrial events, involving the action of heat, light, electricity, etc., and passed to organic phenomena through the chemical process by which the higher compounds have been developed. From this it was inferred by some that his arrangement of the inorganic sciences, had he worked it out, would have been the same as Comte's, viz: Astronomy, Physics, Chemistry.

In 1864 he published his Classification of the Sciences, but even here this question was not answered to the clear comprehension of all, for a classification may be quite a different thing from a genesis or filiation of the groups of phenomena classified. Still, inasmuch as he classed physics and chemistry as 'abstract-concrete' sciences, dealing with the 'elements' of phenomena, while astronomy, geology, biology, psychology and sociology were classed as 'concrete' sciences, dealing with the 'totalities' of phenomena, it was safe to assume that it was to the latter group alone that he proposed to confine his Synthetic Philosophy; and in the larger table of the concrete sciences, after making astronomy coördinate with the combined phenomena of 'astrogeny' and 'geogeny,' he arranged under the last of these groups, biology and the other organic sciences in a scale of progressive subordination.

In an article dated December 3, 1868, and published as an appendix to the first volume of his Principles of Biology (not, of course, to the first edition, which appeared in 1867), he says; "I am placed at a disadvantage in having had to omit that part of the System of Philosophy which deals with Inorganic Evolution * * * which should * * * precede the *Principles of Biology*. Two volumes are missing. The closing chapter of the second, were it written, would deal with the evolution of organic matter —the step preceding the evolution of organic forms;" and he then proceeds to discuss this aspect of the subject in connection with the doctrine of spontaneous generation, respecting which he had been misunderstood by his critics. He deals with it mainly from the chemical standpoint, as, indeed, he also does in the opening chapters of that volume.

Once more, at the very beginning of his Principles of Sociology, the first part of which appeared in 1874, he remarks: "Of the three broadly distinguished kinds of Evolution, we come now to the third. The first kind, Inorganic Evolution, which, had it been dealt with, would have occupied two volumes, one dealing with Astrogeny and the other with Geogeny, was passed over, etc." This would seem to leave no further doubt upon the point in question.

Mr. Ward added that he had recently received a letter from Mr. Spencer in which the series was given complete according to his present view of the subject, and in which he admitted that he had aimed to confine the treatment in the Synthetic Philosophy exclusively to the concrete sciences as defined in his Classification of the Sciences. This latest version of the matter is given in the right-hand column of the following table, the final arrangement of Comte being shown in the left-hand column for porposes of comparison:

System of Auguste Comte.	System of Herbert Spencer.
1. Astronomy.	1. Astronomy.
2. Physics. 3. Chemistry.	2. Geology.
4. Biology (including 5. CerebralBiology).	3. Biology. 4. Psychology.
6. Sociology.	5. Sociology.
7. Ethics.	6. Ethics.

Mr. Ward said that he would himself agree with Spencer in admitting psychology to equal rank with the other members of the series, but that he would differ from both Comte and Spencer in assigning such rank to ethics, which he regarded a subdivision of sociology.

When it is remembered that the question involved is solely that of the natural order of evolution, or genesis of the successive groups of phenomena, and not that of the logical relationships of the sciences that have to deal with them, still less that of the historical order in which these sciences have been cultivated, it seems clear that it makes little difference whether, with Comte, the attention is concentrated more upon the laws governing the phenomena, or, with Spencer, upon the objects manifesting the phenomena. The series is virtually the same in either case, and it may be fairly claimed that it embodies the largest truth which the universe presents.

Mr. Ward's paper was discussed by Mr. J. W. Powell and Mr. Henry Farquhar.

W. C. WINLOCK,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 114th regular meeting was held February 6th. Mr. Schwarz read a communication on the 'Sleeping Trees of Hymenoptera in Southwestern Texas.' Sleeping specimens of two species of Apidæ, *Melissodes pygmæus* and *Coelioxys texana* could frequently be seen near San Diego, Texas, in the early morning hours on the thinnest twigs and thorns of dead bushes of *Celtis pallida.* The sleeping bees hold the twig or thorn firmly grasped with all six legs, and further secure their position by inserting the tips of the widely separated mandibles firmly into the wood. Certain bushes of rather small size are selected by the bees as common sleeping quarters, and on such bushes the two Apidæ are always associated with a Sphegid, *Coloptera wrightii.* The similarity of these sleeping quarters with the so-called 'Butterfly' trees, which are the common sleeping places of *Danais archippus* was discussed.

The paper was discussed by Messrs. Howard, Ashmead, Benton, Gill, Stiles and Fernow. Mr. Ashmead had little doubt of the entire novelty of the observations. Mr. Benton described the position of the honeybee when asleep. Drs. Gill and Stiles and Mr. Fernow discussed the question of sleep and rest with other animals.

Mr. Howard read a paper on the transformations of *Pulex serraticeps*, showing that the common household flea, to which so much attention has been attracted during the past few summers in Northeastern cities, is this common cosmopolitan pest of the cat and dog. He gave the results of careful observations made upon different stages of the insect, and showed that the entire life round from the egg to the adult may occupy in the summer at Washington but sixteen days, the transformations being as rapid as at Calcutta, India. This paper was discussed by Messrs. Patten, Fernow, Barnard, Schwarz, Benton, Ashmead, Marlatt and Gill, who told many stories of the habits and ferocity of fleas in different parts of the world.

L. O. HOWARD,
Recording Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the forty-second meeting of the Geological Society of Washington, held on Wednesday, January 29, 1896, Prof. C. R. Van Hise, of the University of Wisconsin, presented a communication on the Relations of Primary and Secondary Structures in Rocks, being a continuation of the subject considered at the preceding meeting.

The relations between cleavage and fissility were discussed. It was concluded that fissility in many cases is controlled in its direction by a previously developed cleavage. Further, most rocks, at the surface having the property of cleavage which developed under deep seated conditions, show, to a greater or lesser degree, a fissility developed when they were nearer the surface.

The relations of the secondary structures, cleavage and fissility, to bedding were considered. It was shown that there is a tendency for the primary and secondary structures to become parallel or nearly so on the limbs of the folds and to intersect each other at the arches and troughs. In case the folding is close the two structures may be so nearly parallel, except at the short turns of the anticlines and synclines, that the fact that there is a discrepancy anywhere is likely to be overlooked and the conclusion reached that in a given district the two structures are everywhere accordant. This mistake in the past has frequently led to great overestimates of the thickness of formations having slatiness or schistosity.

Prof. Van Hise's observations and conclusions were corroborated and supported by Messrs. Diller, Willis and Keith.

W. F. MORSELL.

NATIONAL GEOGRAPHIC SOCIETY.

AT the regular meeting of the National Geographic Society, held in Washington, D. C., February 7, 1896, Prof. W J McGee, of the Bureau of American Ethnology, presented a communication on 'A Sojourn in Seriland,' which was illustrated by lantern slides. The paper was an account of his recent explorations among a hostile, savage and little known people near the Gulf of California. Mr. McGee gave a brief sketch of the country traversed, with special reference to the flora and fauna and the characteristics of the Seri Indians. A feature of the address was a description of thirst, real and extreme thirst, based on the experience and observation of the speaker.

At the lecture on February 14th, Capt. Z. L. Tanner, United States Navy, commander of the United States Fish Commission Steamer Albatross, described the Commission's method of deep sea fishing, and the forms of submarine life brought up by the dragnet. He also described the voyage of the Albatross from the Atlantic to the Pacific, where she visited the Galapagos Islands and ran several lines of soundings for a submarine cable from California to the Hawaiian Islands. The lecture was illustrated by lantern-slide views of scenes both on shipboard and ashore.

W. F. MORSELL.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held January 15th; eighty-four persons were present. The proposed By-Laws of the Society were first considered and, after discussion and acceptance of a single amendment, they were adopted.

Mr. William Brewster spoke on the natural history of Trinidad, illustrating his remarks with a series of lantern slides, showing views of the vegetation and of various animals. He sketched the general characters of the island, the temperature, climate, etc., and referred to the value of the government resthouses to travellers and naturalists. The fauna and flora of Trinidad is the same as that of the valley of the Orinoco; many of the birds and plants are identical with those found on the Amazon. The absence of annoying insects was especially noteworthy and the protective coloration of the birds universal. The forests with the scarcity of brilliantly colored animals, and the trees noticeable for the smallness of their leaves, gave a first impression not very different from that derived from a New England forest. Mr. Brewster read from his journal various notes on the characteristics and habits of some of the conspicuous mammals, birds, reptiles, and insects, noting especially the habits of the parasol ants and the fungus-hunting ants, and closed with a reference to the palatableness of the Agouti, Lape, Peccary and Howling Monkey.

SAMUEL HENSHAW,
Secretary.

THE TORREY BOTANICAL CLUB.

THE regular meeting of the Torrey Botanical Club was held on Wednesday evening, January 29th, with 38 persons in attendance. Ten new members were elected.

Dr. Valery Havard, U. S. A., read a very interesting paper entitled 'Drink Plants of the North American Indians.'

These plants were divided into three classes:
1st. Plants yielding alcoholic drinks.
Distillation was unknown to the North Ameri-

can aborigines, and their few alcoholic drinks were such as could be readily obtained by the fermentation of saccharine fluids.

In Mexico the two plants commonly used for these drinks were Maize and Maguey (*Agave Americana*), and, to a lesser extent, the fruit of *Opuntia Tuna*, *O. Ficus-Indica*, *Yucca baccata* and *Y. macrocarpa*.

In the United States the only Indians preparing alcoholic drinks were a few southwestern tribes; Apaches, Pimos, Maricopas, Papagos and Yumas, which probably obtained the knowledge from Mexican natives early in this century. The plants used were Maize (only by the Apaches) *Agave Parryi* and *A. Palmeri*, the pulpy fruit of the Pitahaya (*Cereus giganteus* and *C. Thurberi*) and the bean of the Mezquite (*Prosopis juliflora* and *P. pubescens*).

2d. Plants yielding stimulating, deliriant or intoxicating principles other than alcohol.

The Peyote (*Anhalonium Engelmanni* Lem.) and Mescal Buttons (*Lophophora Williamsii Lewinii* Coulter) of the Rio Grande and North Mexico, the Frijolillo (*Sophora secundiflora*) of Texas, several species of *Datura*, specially *D. meteloides*, and the Cassine or Yupon (*Ilex vomitoria*) of the southern Indians from which they prepared their favorite 'Black Drink.'

3d. Plants yielding palatable and nutritive sap or juice, or, by infusion, pleasant beverages or teas.

The saps most used were those of Maples (*Acer saccharum*, *A. saccharinum* and *A. rubrum*), and to a lesser extent that of Box Elder (*Acer negundo*), of the Butternut (*Juglans cinerea*) and of the Birch (*Betula lenta* and *lutea*).

The juicy plants of desert regions: Leaves and stems of several species of *Agave*, *Opuntia* and *Echinocactus*, the Sotol (*Dasylirion Texanum*) and the Sand Food (*Ammobroma Sonoroæ*).

Plants whose seeds were infused in water for their mucilage, sugar, oils, &c.: Maize, Mezquite and several species of Sage, chiefly *Salvia polystachya*, the Chia of Mexico, and *S. Columbariæ*, the Chia of California and Arizona.

Plants with tart fruit imparting a pleasant acidulous taste to water: Several species of Sumach on the Atlantic and Pacific coasts, the Manzanitas (*Arctostaphylos Manzanita* and *tomentosa*) of California, the Bulberry of the Missouri region (*Shepherdia argentea*), the Soapberry of the Northern States (*S. Canadensis*) and various species of Barberries (*Berberis*).

Plants containg mostly volatile oils, making agreeable, fragrant teas: Sassafras, Spice bush (*Benzoin Benzoin*), Wintergreen (*Gaultheria procumbens*), New Jersey Tea (*Ceanothus Americanus*), Labrador Tea (*Ledum Greenlandicum*), Sweet Goldenrod (*Solidago odora*), Pennyroyal (*Hedeoma pulegioides* and *Drummondi*), *Croton corymbulosus* and *suaveolens*.

Dr. John K. Small presented his 'Preliminary Notes on the North American Species of Saxifraga,' proposing to separate from that genus the two new genera Japsonia and Saxifragopsis.

Dr. N. L. Britton read a paper entitled 'New or Noteworthy species of Cyperaceae.' He proposed a number of new species, reduced two species and submitted a large number of valuable notes, especially on geographical distribution.

Dr. Britton also submitted observations and specimens in support of Pursh's *Lilium umbellatum*, a species which has been uniformly accepted in herbaria as *L. Philadelphicum*. This view was endorsed by Mr. Rydberg.

H. H. RUSBY,
Secretary.

NEW BOOKS.

Physiological Papers. By M. NEWELL MARTIN. Baltimore, Johns Hopkins Press. 1895. Pp. vii.+264.

Elements of the Theory of Functions of a Complex Variable. By DR. H. DURÈGE. Authorized translation from 4th German Edition. George Egbert Fisher and Isaac J. Schwatt. Philadelphia, G. E. Fisher and I. J. Schwatt. 1896. Pp. xiii.+288.

A Text-Book of Gas Manufacture for Students. JOHN HORNBY. London, George Bell & Sons. New York, Macmillan & Co. 1896. Pp. vii+261. $1.50.

Naturwissenschaftliche Einführung in die Bakteriologie. FERDINAND HUEPPE. Wiesbaden, C. W. Kreidel. 1896. Pp. viii. + 268. M. 6.

Die Lehre von den spezifischen Sinnesenergien. RUDOLF WEINMANN. Hamburg and Leipzig, Leopold Voss. 1895. Pp. 96. 1895. M. 2.25.

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SCIENCE

FRIDAY, FEBRUARY 28, 1896.

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

REPORT OF THE FOURTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF NATURALISTS, PHILADELPHIA, DECEMBER 26–27, 1895.

AT the first session, Thursday, December 26, 2 P. M., President Cope called for the reports of committees appointed at the Baltimore meeting: It was reported that two microtomes had been purchased by the duly authorized committee and placed at the Naples Station for the use of American students under appointment of the Smithsonian Institution. The Committee on Bibliography announced that their report had, according to instructions, been published in SCIENCE and the *American Naturalist.* The Treasurer's report was read and, after being duly audited, received.

Dr. Stiles reported that the present term of control of a table at the Naples Station would cease on June 8, 1896; that during this term eight men had been appointed to the table, and that the table had not remained unoccupied for a single month. He presented a memorial, addressed to the Secretary of the Smithsonian Institution, asking that the control of the table be continued, and requested the Society to approve the steps already taken by him and authorize him to continue. It was so voted, and on motion of Dr. Morgan it was also voted that the President appoint a committee of two, which committee should communicate to the Secretary of the Smithsonian Institution the action of the Society. Profs. Morgan and Conn were appointed on this committee.

Messrs. Lucas, Morgan, Gill, Stiles and Macloskie were appointed a committee to nominate officers for the ensuing year.

The Society then listened to the address of the President, 'The Formulation of the Natural Sciences,' and to the following paper:

Note on the Laboratory Teaching of Large Classes, by BURT G. WILDER, M. D., Professor of Physiology, Vertebrate Zoölogy, and Neurology, Cornell University.

To my great regret a year ago the simultaneous meeting of the Association of American Anatomists prevented my participation in the discussion of this topic. Our experience at Cornell has been both extensive and successful. In 1880 for vertebrate zoölogy, and in 1886 for physiology, was introduced the actual examination and dissection of representative forms and important organs by members of large classes of general students numbering from 40 to 181. For the sake of distinguishing these comparatively brief and superficial exercises from the laboratory work to which they serve as an introduction, the word *Practicum* is employed; but I first heard it from the lips of Prof. Shaler many years ago, and he perhaps got it from the Germans.

The following practical points are to be noted:

1. The advantages of Japanese napkins over towels.

2. The convenience of placing the text and plates of directions upon a two-sided rack running lengthwise of the middle of a table and secured by a clamp at each end so as to be easily removed.

3. The cheerfulness with which these general students repay to the Treasurer of the University the cost of the material and supplies, amounting to about $3.00 for each of the courses.

4. The almost uniform interest manifested in the work even by those who may shrink from it at first. Not more than one in five hundred has sought to be excused.

5. The possibility of preparing and storing the material for such large classes. For example, this fall each of the class of 186 has dissected the eye, brain and heart of the sheep and the viscera and certain muscles of a cat. For brains Dr. Fish's formalin mixture is satisfactory, but the hearts of cats are prepared with alcohol, as described by me before this Society in 1885 and 1890.

6. The desirability of requiring as much as is now done here at the practicums in both physiology and vertebrate zoölogy for admission to the University. Although elementary physiology has been an entrance requirement here since 1877, the extent of practical familiarity with organisms is very slight. Nevertheless I believe it can be increased by general and persistent effort.

After the reading of the above paper, Dr. Stiles requested that the Society elect a representative to meet with similar representatives appointed by the Smithsonian Institution and the American Ornithological Union, to consult with and advise the American member of the International Commission on Codes of Nomenclature. Prof. Cope was duly elected.

The President then announced to the Society the death, since the previous meeting, of James D. Dana and John A. Ryder.

The Society then adjourned.

SECOND SESSION, FRIDAY, DECEMBER 27, 9.30 A. M.

President Cope called for the report of the Nominating Committee, which was submitted, and the following officers were elected for the ensuing year: President, W. B.

Scott, of Princeton College, N. J.; Vice-Presidents, W. G. Farlow, of Harvard University; C. O. Whitman, of the University of Chicago; Theodore Gill, of the Smithsonian Institution; Secretary, H. C. Bumpus, of Brown University; Treasurer, John B. Smith, of Rutgers College; Executive Committee, Horace Jayne, of the University of Pennsylvania; William F. Ganong, of Smith College.

The business being finished, the Society listened to the annual discussion, which is printed below.

At the close of the discussion, on motion of Prof. Heilprin, it was voted that a committee of three be appointed by the President to inquire into the practicability and feasibility of the exploration of the Antarctic Continent and to report at the next meeting of the Society. The President appointed Professors Heilprin, Osborn and Goodale. The Society then adjourned.

H. C. BUMPUS,
Secretary.

*THE FORMULATION OF THE NATURAL SCIENCES.**

FORMULATION is the method of presentation of the forms of our thoughts. Our observations of the facts of material nature are embodied in such classifications as we think best express their relations, and by means of these classifications expressed in language, we convey to others our conclusions in the premises. As the vehicle of presentation, formulation is one of the aspects of language, which as the medium of communication between men, enables them to accumulate knowledge. It is highly important then that the system of formulation should be uniform, so as to convey definite meaning and preserve the truth. The vast number of facts to be marshaled in orderly array, which constitute the natural sciences, require a correspondingly complex and exact formulation. The advent of the doctrine of evolution into the organic sciences involves the necessity of making such readjustments of our method of formulation as may be called for. It is with reference to this condition and the present action of naturalists regarding it, that I address you to-day. The subject may be considered under the three heads of Taxonomy, Phylogeny, and Nomenclature.

I. TAXONOMY.

Taxonomy or classification is an orderly record of the structural characters of organic beings. The order observed is an order of values of these characters. Thus we have what we call specific or species value, generic value, family value, and so on. These values are not imaginary or artificial, as some would have us believe, but they are found in nature. Their recognition by the naturalist is a matter of experience, and the expression of them is a question of tact. Their recognition rests on a knowledge of morphology, or the knowledge of true identities and differences of the parts of which organic beings are composed. The formulation of these values in classification foreshadows the evolutionary explanation of their origin, and is always the first step necessary to the discovery of a phylogeny.

Taxonomy, then, is, and always has been, an arranging of organic beings in the order of their evolution. This accounts for the independence of the values of taxonomic characters, of any other test. Thus, no character can be alleged to be of high value because it has a physiological value, or because it has no physiological value. A physiological character may or may not have a taxonomic value. The practical taxonomist finds a different test of values, which is this. He first endeavors to dis-

* Presidental address delivered before the American Society of Naturalists in Philadelphia, December 26, 1895.

cover the series of organic forms which he studies. He learns the difference between its beginning and its ending. His natural divisions are the steps or stages which separate the one extremity from the other. The series may be greater or they may be lesser, *i. e.*, more or less comprehensive, and it is to the series of different grades that we give the different names of the genus, family, order, etc.

We know that the characters of specific value in given cases are usually more numerous than those of higher groups. We know that they are matters of proportions, dimensions, textures, patterns, colors, etc., which are many. The characters of the higher groups, on the contrary, are what we call structural, *i. e.*, the presence, absence, separation or fusion of elemental parts, as estimated by a common morphologic standard ; and it is the business of the morphologist to determine each case on this basis. In these characters lies the key to the larger evolution, that of the higher aggregations of living things. On the contrary, the study of the origin of species characters gives us the evolution of species within the genus, but nothing more, except by inference.

Classification, then, is a record of characters, arranged according to their values. There still lingers, in some quarters, a different opinion. This holds that there is such a thing as a 'natural system,' as contrasted with 'an anatomical system.' Examination shows that the supporters of this view suppose that there is some bond of affinity between certain living beings which is not expressed in anatomical characters. A general resemblance apparent to the eye is valued by them more highly than a structural character. If this 'general appearance' is analyzed, however, it is found to be simply an aggregate of characters usually of the species type, which by no means precludes the presence of anatomical differences. And these anatomical differences may indicate little relationship, in spite of the general resemblance of the species concerned, or they may have only the smallest value attached to such characters, *i. e.*, the generic. It is with regard to the generic characters that the chief difference of practice exists. But it is clear that the record of this grade of characters cannot be modified by questions of specific characters. The two questions are distinct. Both represent nature, and must be formulated. In fact, I have long since pointed out that the same species, so far as species characters go, may have different generic characters in different regions. Also that allied species of different genera may have more specific characters in common than remote species of the same genus.

The anticipation naturally intrudes itself that the characters which distinguish the steps in a single evolutionary or genealogical line must disappear with discovery, and new ones appear, and that they must be all variable at certain geological periods, and hence must become valueless as taxonomic criteria. And it is therefore concluded that our systematic edifice must lose precision and becomes a shadow rather than a reality. I think that as a matter of fact this will not be the result, and for the following reasons: In the first place, when, say all the generic forms of a genealogical line, shall have been discovered, we will find that each one of them will differ from its neighbor in one character only. This naturally follows from the fact that two characters rarely, if ever, appear and disappear contemporaneously. Hence, generic characters will not be drawn up so as to include several points. For a while, there will be found to be combinations of two or three characters which will serve as definitions, but discovery will relegate them to a genus each. Each of these characters will be found to have what I have called the 'expression point,' or the moment of completeness, before which it cannot be said to exist. In illustration I cite the case of the eruption of a tooth. Before it passes the line of the alveolus it is not in use; it is not in place as an adult organism. When it passes that line it has become mature, has reached its expression point, comes into functional use, and may be counted as a character. Such will be found to be the case with all separate parts; there always will be a time when they are not completed and then there will be a time when they are. These lines, then, will always remain as our boundaries, as they are now, for all natural divisions from the generic upwards. This condition cannot exist in characters of proportionate dimensions, which will necessarily exhibit complete transitions in evolution. Hence, proportions alone can only be used ultimately as specific characters.

Some systematists desire to regard phyletic series as the only natural divisions. This may be the ultimate outcome of paleontologic discovery, but at present such a practice seems to me to be premature. In the first place, as all natural divisions rest on characters, we must continue to depend on their indications, no matter whether the result gives us phyletic series or not. In the next place, we must remember that we have in every country interruptions in the sequence of the geological formations, which will give us structural breaks until they are filled. There are also periods when organic remains were not preserved; these also will give us interruptions in our series. So we shall have to adhere to our customary method without regard to theory, and if the phyletic idea is correct, as I believe it to be, it will appear in the final result, and at some future time.

Authors are frequently careless in their definitions. Very often they include, in the definition of the order, characters which belong in that of the family, and in that of the family those that belong in the genus. Characters of different values are thus mixed. The tendency, especially with naturalists who have only studied limited groups, is to overestimate the importance of characters. Thus the tendency is to propose too many genera and other divisions of the higher grades. In some groups structure has been lost sight of altogether, and color patterns, dimensions, and even geographical range, treated as characters of genera. As the mass of knowledge increases, however, the necessity for precision will become so pressing that this kind of formulation will be discarded, and definitions which mean something will be employed. Search will be made especially for that one character which the nature of the series renders it probable will survive, as discoveries of intermediate forms are successively made, and here the tact and precision of the taxonomist has the opportunity for exercise. In the selection of these characters, one problem will occasionally present itself. The sexes of the same species sometimes display great disparity of developmental status, sometimes the male, but more frequently the female, remaining in a relatively immature stage, or in others presenting an extraordinary degeneracy. In these cases the sex that displays what one might call the genius, or in other words, the tendency, of the entire group, will furnish the definitions. This will generally be that one which displays the most numerous characters. In both the cases mentioned the male will furnish these rather than the female; but in a few cases the female furnishes them. The fact that both sexes do not present them does not invalidate them, any more than the possession of distinct reproductive systems would refer the sexes to different natural divisions.

I have seen characters objected to as of little value because they were absent or inconstant in the young. I only mention the objection to show how superficially the subject of taxonomy may be treated. So that a character is constant in the adult, the time of its appearance in development is immaterial in a taxonomic sense, though it may have important phylogenetic significance.

II. PHYLOGENY.

The formulation of a phylogeny or genealogy involves, as a preliminary, a clear taxonomy. I refer to hypothetical phylogenies, such as those which we can at present construct are in large part. A perfect phylogeny would be a clear taxonomy in itself, so far as it should go, did we possess one; and such we may hope to have ere long, as a result of paleontological research. But so long as we can only supply parts of our phyletic trees from actual knowledge, we must depend on a clear analysis of structure as set forth in a satisfactory taxonomy, such as I have defined above.

Confusion in taxonomy necessarily introduces confusion into phylogeny. Confusion of ideas is even more apparent in the work of phylogenists than in that of the taxonomists, because a new but allied element enters into the formulation. It is in the highest degree important for the phylogenist, whether he be constructing a genealogic tree himself or endeavoring to read that constructed by some one else, to be clear as to just what it is of which he is tracing the descent. Is he tracing the descent of species from each other, or of genera from each other, or of orders from each other, or what? When I trace the phylogeny of the horse, unless I specify, it cannot be known whether I am tracing that of the species *Equus caballus*, or that of the genus Equus, or that of the family Equidæ. When one is tracing the phylogeny of species, he is tracing the descent of he numerous characters which define a species. This is a complex problem, and but little progress has been made in it from the paleontologic point of view. Something has been done with regard to the descent of some living species from each other. But when we are considering the descent of a genus, we restrict ourselves to a much more simple problem, *i. e.*, the descent of the few simple characters that distinguish the genus from other genera. Hence, we have made much more progress in this kind of phylogeny than with that of species, especially from the paleontologic point of view. The problem is simplified as we rise to still higher divisions, *i. e.*, to the investigation of the origin of the characters which define them. We can positively affirm many things now as to the origin of particular families and orders, especially among the Mammalia, where the field has been better explored than elsewhere.

It is in this field that the unaccustomed hand is often seen. Supposing some phyletic tree alleges that such and such has been the line of descent of such and such orders or families, as the case may be; soon a critic appears who says that this or that point is clearly incorrect, and gives his reasons. These reasons are that there is some want of correspondence of generic characters between the genera of the, say, two families alleged to be phyletically related. And this want of correspondence is supposed to invalidate the allegation of phyletic relation between the families. But here is a case of irrelevancy; a generic character cannot be introduced in a comparison of family characters. In the case selected, the condition is to be explained by the fact that although the families are phyletically related, one or both of the two juxtaposed genera through which the transition was accomplished has or have not been discovered. The same objection may be made against an allegation of descent of some genus from another, because the phyletic relation between the known species of the two genera cannot be demonstrated. I cite as an example the two genera, Hippotherium and Equus, of which the latter has been asserted with good reason to have descended from the former. It has been shown, however, that the *Equus caballus* could not have descended from the European *Hippotherium mediterraneum*, and hence some writers have jumped to the conclusion that the alleged phyletic relation of the two genera does not exist. The reasons for denying this descent are, however, presented by specific characters only, and the generic characters are in no way affected. Further, we know several species of Hippotherium which could have given origin to the *Equus caballus*, probably through intermediate species of Equus.

Some naturalists are very uncritical in criticising phylogenies in the manner I have just described. They often neglect to ascertain the definitions given by an author to a group alleged by him to be ancestral; but fitting to it some definition of their own, proceed to state that the ancestral position assigned to it cannot be correct, and to propose some new division to take its place. It is necessary to examine, in such cases, whether the new group so proposed is not really included in the definition of the old one which is discarded.

The fact that existing genera, families, etc., are contemporary need not invalidate their phyletic relation. Group No. 1 must have been contemporary with group No. 2, at the time that it gave origin to the latter, and frequently, though always, a certain number of representatives of group No. 1 have not changed, but have persisted to later periods. Some genera, as *e. g.*, Crocodilus, have given origin to other genera (*i. e.*, Diplocynodon) and have outlasted it, for the latter genus is now extinct. The lung fishes, Ceratodus, are probably ancestral to the Lepidosirens, but both exist to-day. Series of genera, clearly phyletic, or Batrachia Salientia, are contemporaries. Of course we expect that the paleontologic record will show that their appearance in time has been successive. But many ancestors are living at the same modern period as their descendants, though not always in the same geographic region.

III. NOMENCLATURE.

Nomenclature is like pens, ink and paper; it is not science, but it is essential to the pursuit of science. It is, of course, for convenience that we use it, but it does not follow from that that every kind of use of it is convenient. It is a rather common form of apology for misuse of it to state that as it is a matter of convenience, it makes no difference how many or how few names we recognize or use. An illustration of this bad method is the practice of subdividing a genus of many species into many genera, simply because it has many species. The author who does this ignores the fact that a genus has a definite value, no matter whether it has one or five hundred species. I do not mean to maintain that the genus or any other value has an absolute fixity in all cases. They undoubtedly grade into each other at particular places in the system, but these cases must be judged on their own merits. In general there is no such gradation.

Nomenclature is then orderly because the things named have definite relations which it is the business of taxonomy, and nomenclature its spokesman, to state. Here we have a fixed basis of procedure. In order to reach entire fixity, a rule which decides between rival names for the same thing is in force. This is the natural and rational law of priority. With the exception of some conservative botanists, all naturalists are, so far as I am aware, in the habit of observing this rule. The result of a failure to do so is self-evident. There is, however, some difference of opinion as to what constitutes priority. Some of the aspects of the problem are simple, others more difficult. Thus there is little or no difference of opinion as to the rule that the name of a species is the first binomial which it received. This is not a single date for all species, since some early authors who used trinomials and polynomials occasionally used binomials. A second rule which is found in all the codes, is that a name in order to be a candidate for adoption, must be accompanied by a descriptive diagnosis or a plate. As divisions above species cannot be defined by a plate, a description is essential in every such case.

It is on the question of description that a certain amount of difference of opinion exists. From the codes of the associations for the advancement of science, and of the zoölogical congresses, no difference of opinion can be inferred, but the practice of a number of naturalists both zoölogists and paleontologists in America, and paleontologists in Europe, is not in accord with the rule requiring definition of all groups above species. It has always appeared to me remarkable that a rule of such self-evident necessity should not meet with universal adoption. However, the objections to it, such as they are, I will briefly consider. It is alleged that the definitions when first given are more or less imperfect, and have to be subsequently amended, hence it is argued they have no authority. However, the first definitions, if drawn up with reference to the principles enumerated in the first part of this address, need not be imperfect. Also an old-time diagnosis of a division which we have subsequently found it necessary to divide, is not imperfect on that account alone, but it may be and often is the definition of a higher group. But you are familiar with all this class of objections and the answers to them, so I will refer only to the positive reasons which have induced the majority of naturalists to adhere to the rule.

It is self-evident that so soon as we abandon definitions for words, we have left science and have gone into a kind of literature. In pursuing such a course we load ourselves with rubbish, and place ourselves in a position to have more of it placed upon us. The load of necessary names is quite sufficient, and we must have a reason for every one of them, in order to feel that it is necessary to carry it. Next, it is essential that every line of scientific writing should be intelligible. A man should be required to give a sufficient reason for everything that he does in science. Thus much on behalf of clearness and precision. There is another aspect of the case which is ethical. I am aware that some students do not think that ethical considerations should enter into scientific work. To this I answer that I do not know of any field of human labor into which ethical considerations do not necessarily enter. The reasons for sustaining the law of priority are partly ethical, for we instinctively wish to see every man credited with his own work, and not some other man. The law of priority in nomenclature goes no further in this direction than the nature of each case requires. Nomenclature may be an index of much meritorious work, or it may represent comparatively little work; but it is to the interest of all of us that it be not used to sustain a false pretence of work that has not been done at all. By insisting on this essential test of honest intentions we retain the taxonomic and phylogenetic work within the circle of a class of men who are competent to it, and cease to hold out rewards to picture makers and cataloguers.

Another contention of some of the nomenclators who use systematic names proposed without description, is, that the spelling in which they were first printed must not be corrected if they contain orthographical and typographical errors. That this view should be sustained by men who have not had the advantage of a classical education, might not be surprising, although one would think they would prefer to avoid publicly displaying the fact, and would be willing to travel some distance in order to find some person who could help them in the matter of spelling. But when well educated men support such a doctrine, one feels that they have created out of the law of priority a fetish which they worship with a devotion quite too narrow. The form of our nomenclature being Latin, the rules of Latin orthography and grammar are as incumbent on us to observe, as are the corresponding rules of English grammar in our ordinary speech. This cult, so far as I know, exists only in the United States and among certain members of the American Ornithologists' Union. The preservation of names which their authors never defined; of names which their proposers misspelled; of names from the Greek in Greek instead of Latin form ; of English hyphens in Latin composition; and of hybrid combinations of Greek and Latin, are objects hardly worth contending for. Some few authors are quite independent of rules in the use of gender terminations, but I notice the A. O. U. requires these to be printed correctly. Apart from this I notice in the second edition of their check list of North American Birds, just issued, only eighteen misspellings out of a total number of 768 specific and subspecific names, and the generic and other names accompanying. These are of course not due to ignorance on the part of the members of this body, some of whom are distinguished for scholarship, but because of an extreme view of the law of priority.

In closing I wish to utter a plea for euphony and brevity in the construction of names. In some quarters the making of such names is an unknown art. The simple and appropriate names of Linneus and Cuvier can be still duplicated if students would look into the matter. A great number of such names can be devised by the use of significant Greek prefixes attached to substantives which may or may not have been often used. Personal names in Greek have much significance, and they are often short and euphonious. The unappropriated wealth is so great that there is really no necessity for poverty in this direction. It should be rarely necessary, for instance, to construct generic names by adding prefixes and suffixes of no meaning to a standard generic name already in use.

E. D. COPE.

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*THE ORIGIN AND RELATIONS OF THE FLORAS AND FAUNAS OF THE ANTARCTIC AND ADJACENT REGIONS.**

The Geology of the Antarctic Regions. ANGELO HEILPRIN, Philadelphia Academy of Natural Sciences.

Reviewing our present knowledge of the Antarctic regions, Prof. Heilprin stated that it rests almost where it was a half-century ago, when Sir James Clark Ross (1841, 1842) made his memorable cruises in the 'Erebus' and 'Terror,' and attained the high southing of 78° 10′. This was at a position almost due south of New Zealand, along a coast line, sharply defined by elevated mountain masses, to which the daring British navigator gave the name of Victoria Land. At that time other patches of ice bound land, or what was presumed to be land, had already been discovered and named by Bellamy, Biscoe, Dumont d' Urville, and Wilkes—such as Clarie Land, Sabrina Land, etc., south of the Australian continent; Enderby Land, Kemp Land, Graham and Alexander Lands, south of Patagonia—and from these had been constituted the Antarctic continent of Wilkes and of many modern geographers. Murray,

*Report of the discussion before the American Society of Naturalists, Philadelphia, December 27, 1895.

especially, has been strenuous in upholding the actuality of such a continent, but to the present time it cannot be said that its existence has been demonstrated. A number of considerations speak in favor of it, but many more facts than we now possess will be needed before anything like a satisfactory determination of this question can be assumed. It is significant in this connection that both Ross and Petermann, to whom as explorer and student we owe the better part of our knowledge of Antarctica, inclined their views against the existence of such a southern continent. In their opinions the reported land masses are of an island character, bound together perhaps not even permanently, by a vast (frequently shifting?) ice pack, the edge of which (only in small part the terminal wall of giant glaciers) is the 'great Antarctic barrier' of geographers and navigators. How far the vertical icebarrier is confluent with the cemented pack remains yet to be determined.

The only important addition to our knowledge of true Antarctica that has been made since Ross's voyage belongs to the close of the year 1893, when Larsen penetrated, in the region of the Graham Land complex, to Lat. 68° 10′ S., and brought back with him a 'departure' in the geological concept of the region under consideration. The finding of Tertiary fossils (Cytherea, Natica, etc.,) on Seymour Island (Cape Seymour) is the opening vista in an investigation which has heretofore been considered closed, and at once affords, to use a business term, a basis for consideration. Not less significant is the finding at the same locality of an abundance of tree-remains (conifers—Arancaria ?). These fragments at least show that some part of Antarctica was of the same kind of construction as the continents generally, and their special facies immediately suggests a South American relationship. Previous to 1893 the only rocks known from the ice-bound region of the far South were granites, gneisses (and related schists), the strictly eruptive and trappean rocks, and certain red sandstones (Piner's Island—Triassic?) from a very limited area. Most (and perhaps nearly all) of the higher mountains are distinctly of a volcanic nature, and many of them bear huge craters on their summits. Ross found Erebus in eruption at the time of his visit (1841), and Larsen found the mountains of Christensen and Lindenberg Islands similarly active in 1893–94. Borchgrevink, who sailed over a portion of Ross's course in 1894–95, attaining off Victoria Land, with clear water ahead of him, Lat. 74° S., confirms in almost every detail the observations of his predecessor, adding some additional facts regarding the large glaciers which descend from the heights of the Sabine Mountains. He was the first to set foot on the mainland (or main island) of Antarctica, and to him science also owes the first discovery within this realm of a rock-covering vegetation (lichens?—on Possession Island and Cape Adare).

It can hardly be said that we know much regarding either the source or the nature of the vast ice mass which makes up nearly the whole of visible Antarctica; it may or may not be in principal part of glacial construction; it may be largely or mainly an ocean-surface accumulation, extending back in its formation through hundreds or thousands of years. Until we know what is below or behind it, this question will remain unanswered. Giant glaciers there are, and an abundance of them; but over enormous expanses, where the ice barrier presents an impassable front, no visible distant ice cap, like the one of Greenland, has been detected.

In its relations to the other continents there is reason to believe that Antarctica, whether as a continent or in fragmented parts, had a definite connection with one or more of the land masses lying to the north, and the suspicion can hardly be avoided that such connection was, if with nothing else, with at least New Zealand (and through it, with Australia) and Patagonia. In the fragmented parts of Graham Land archipelago and the outlying South Orkney and South Georgian islands, we seem to have the bond of connection with the South American main; or, more specifically, a line of curvature of the great Andean chain, which, in its broken parts, can still be traced far beyond its present continental termination. If this concept is a true one, it places before us a parallel to the Andean curvature in the northern part of the South American Continent, where the mountain system is deflected off into the broken mass of the Lesser Antilles; to the Aleutian flexure of the Cordilleran system of North America; and to the 'Apennine-Atlas' and 'Carpathian-Balkan' flexures of the Alpine mountains, the nature of which has been so clearly stated by Suess. In fact, it is hardly possible that any very extensive meridianal or latitudinal mountain chain could have been forced up through contractional force without some such deflection being represented in one or more parts of its course; and where these deflections are found they are almost certain to be areas of breakage. The disruption of the Andean system is still (or has until recently been) taking place, as is evidenced in a portion of the Chilian archipelago.

Antarctica Palæontology. PROF. W. B. SCOTT, Princeton University.

It is a truism that the most satisfactory evidence concerning the former existence of land connections which have long since disappeared beneath the sea, is to be derived from the distribution of land animals, recent and fossil. In the northern hemisphere this evidence is very extensive for all of the great land masses, and for those later divisions of geological time in which terrestrial life began to play an important part. In the southern hemisphere the case is unfortunately different, only South America having, as yet, yielded numerous and well preserved remains of Tertiary mammals. Pleistocene fossils, which have an important though somewhat inconclusive bearing upon the problem of the Antarctic continent, occur in other regions, such as Madagascar, Australia and New Zealand, but the evidence is still fragmentary and leaves much to be desired.

In the Permian we first find indications of a type of fossils, common to the southern hemisphere and distinct from the contemporary life of the northern. This is the much discussed *Glossopteris* Flora, characterized by the fern of that name, and by an assemblage of plants which is more like the Triassic than the Permian of the northern continent. The *Glossopteris* Flora has been found in India, South Africa, Australia and, quite lately, in the Argentine Republic, and obviously points to an Antarctic center of distribution. Though the distribution of the *Glossopteris* Flora does not demonstrate that the lands in which it occurs were all connected together, yet it renders such connection probable. Judging from the analogy of the existing land masses, it seems likely that the connection was rather by means of a circumpolar continent with northward extensions than through east and west land-bridges, or a great single continent occupying the site of the Indian, South Atlantic and South Pacific Oceans.

The evidence of Mesozoic fossils is very unsatisfactory. Lydekker has called attention to the likeness between the Jurassic Dinosaurs of India, South Africa and Patagonia, and, so far as it goes, this fact would indicate a general persistence of the same land connections as those which obtained in Permian times.

When we reach the Tertiary, important facts become available, but, as in the earlier ages, too fragmentary to be conclusive. A long succession of Tertiary land faunas is known only from South America. Even the most cursory examination of these faunas shows in the most unmistakable manner the extreme isolation of South America. The oldest of the Tertiary formations of Patagonia, the *Pyrotherium* beds have yielded a fauna which promises to prove of the highest interest, but as yet it is so imperfectly known that it cannot be employed in the solution of the Antarctic problem. The earlier *Miocene* (Santa Cruz) mammals of that continent are totally different from those of the northern landmasses, so much so that the correlation of horizons becomes a matter of extreme difficulty. The hoofed animals all belong to orders unknown in the north, *Toxodontia, Typotheria, Litopterna*, and the principal constituents of the fauna are immense numbers of *Edentates*, *Marsupials* and *Rodents*, with several platyrrhine monkeys. No artiodactyls, perissodactyls, proboscidians, Condylarthra or Amblypoda, neither Insectivora, Cheiroptera, Carnivora or Creodonta are known. The Edentates are all of the specifically South American type, sloths, armadillos and the like. The Rodents also are very much like those which still characterize the region, though most of the genera are distinct; they are all Hystricomorpha, neither squirrels, marmots, beavers, rats or mice, hares or rabbits occurring among them. The Primates are typically neotropical and evidently belong to the platyrrhine group. The Marsupials are partly opossums, more or less like those which still inhabit the Americas, and, what is at first sight very surprising, partly of Australian type. The latter contain both diprotodont forms (*Abderites, Acdestis Epanorthus*) allied to the existing *Hypsiprymnus* and polyprotodont genera (*Protoproviverra, Cladosictis*, etc.), the affinity of which to the *Dasyuridæ* is clear. Ameghino, it is true, places these latter forms in a new order, the *Sparassodontia*, but this seems unnecessary and misleading.

The fauna of the succeeding 'Patagonian formation' is of exactly the same general character and contains no new elements, but merely somewhat more advanced genera of the same orders, while the Marsupials are much reduced in numbers and importance.

In the Pliocene (Monte Hermoso) appear the first traces of the union with North America, in the presence of mastodons, horses, tapirs, deer, llamas and true carnivores, and from that time till far into the Pleistocene the intermigrations between the two continents kept up, until a large number of common types had been established.

The curious composition of the South American mammalian fauna in Tertiary times presents us with some very well-defined but extremely difficult problems. (1.) How is the presence of groups to be explained, which have a clear relationship to those belonging to the Northern hemisphere, namely the Primates, Ungulates and Rodents? An easy short cut out of the difficulty would be to assume that the relationship is only apparent and due to convergent development. It is, of course, possible that such is the true explanation, but it is most unlikely, and in the absence of any evidence in its favor we need not stop to discuss it. Much more probable is it that these groups point to some connection, direct or indirect, with the northern hemisphere, either in late Mesozoic or early Tertiary times. One would naturally expect to find that this connection was by way of North America, but there are grave difficulties in the way of such a view. As we have seen, the indigenous South American rodents were all hystricomorphs, and while this group is represented in Europe, in later Oligocene beds, it does not appear in North America till the end of the Miocene or beginning of the Pliocene, and is very scantily represented here to-day. The Ungulates are much more distantly related to those of the north and can be connected only by remote ancestors, for the divergence is very striking in the oldest South American forms yet recovered. If the connection with the north was not by means of North America it can only have been through Africa. Admitting such connection, it is much more likely to have been due to the junction of both continents with the Antarctic land mass than to a Transatlantic bridge. Such a mode of connection would explain the very wide divergences in the character of the mammalian faunas which still exist between Africa and South America, for a circumpolar land would very likely oppose climatic barriers to migration, and confine that migration to comparatively few groups. (2) The presence of numerous marsupials of distinctively Australian type in the Tertiary rocks of South America is very strong evidence indeed that both of those continents were connected with the Antarctic land. The Australian marsupials have been much misunderstood and many observers appear to think that Australia is a sort of museum which has preserved Jurassic types to this day. As a matter of fact, these marsupials are an extremely diversified and modernized assemblage of forms, which have paralleled the placental orders in a remarkable way. Their structure is, it is true, fundamentally primitive, but their many and divergent adaptions are modern. That these marsupials indicate a land connection between South America and Australia can hardly be denied, for none of them have ever been found in any northern continent. If it be asked why this supposed migration was all in one direction, and why South American mammals did not reach Australia, several possible explanations suggest themselves. (a) The marsupials may have originated in South America and, covering the South Polar lands, have reached Australia, which was then severed from Antarctica, before the Placentals had made their appearance in South America. (b) Placentals may have reached Australia but not kept a foothold there, finding conditions unfavorable to them. These possibilities seem very unlikely and much more probable is a third explanation. (c) The Australian connection with Antarctica first existed and allowed the marsupials to spread over the polar lands. Before South America became connected with the circumpolar area, the latter was severed from Australia. Until Tertiary mammals are recovered in Australia, explanation of these curious circumstances must remain conjectural. What is known of Australian Pleistocene mammals indicates that nothing had reached that continent from South America.

Another line of evidence which trends in the same general direction as that which we have already considered is given by the Pleistocene birds of the southern hemisphere to which attention has been directed by Forbes, and more recently by Milne Edwards and others. The weight which should be given to evidence of this kind is very difficult to determine, because of the uncertainty which still obtains concerning the real relationship of the birds in question. The extinct types of wingless rails which are found in New Zealand, the Chatham Islands, the Mascarene Islands are believed by many to indicate land bridges, while Æpyornis, of Madagascar, the Moas of New Zealand, the Emeus of Australia, and the gigantic Tertiary birds of the Argentine Republic (Brontornis, Phororhacus, Opisthodactylus), are supposed to be branches of the same stock of Ratitæ. Until, however, we learn a great deal more than is known at present with regard to the phylogeny and relationships of these great birds, I personally do not feel at all assured that we can safely reason from their distribution to problems of former land connections. On the other hand, it should be noted that this distribution is in harmony with the results reached by study of the mammals.

In conclusion, it may be observed that the facts of paleontology may best be explained on the assumption that the Antarctic land mass has at one time or another been connected with Africa, Australia and South America, which formerly radiated from the South Pole as North America and Eurasia now do from the North Pole. While this seems a highly probable assumption, much remains to be done before the history of the southern continents is as well known as that of the northern ones, and in particular many questions must remain open until the Tertiary mammals of Africa and Australia shall have been recovered. It is interesting to observe that we are again approximating to the views expressed by Rütimeyer in 1867.

Botany. Prof. N. L. Britton, Columbia College.

Prof. Britton took up the subject from the standpoint of Antarctic botany. He remarked that as nothing worth consideration was known of the flora of the Antarctic Continent, the inquiry must be restricted to a consideration of the vegetation of the extreme southern parts of South America, South Africa, New Zealand and the islands of the South Pacific Ocean. Genera of wide distribution cannot enter as factors in the inquiry, except in cases where closely related or identical species occur in two or more of these areas. Genera and species of circumtropical distribution must be considered with caution, because this distribution may or may not have a bearing on the problem. He noted that this circumtropical distribution of plants is well marked, large numbers of genera and species being common to the warmer parts of America, Australasia and Asia, and some common to tropical America and Africa. Types of cosmopolitan distribution must obviously be ignored. Types of simple organization, typically of wide distribution, cannot fairly be considered.

He submitted the following cases of distribution, selected from widely different families from the Bryophytes upward:

Musci. *Andrœa pseudosubulata.* Fuegia and Australia. *Campylopus xanthophyllus.* Chile and New Zealand. The genus *Codonoblepharum* contains about eleven species, six in southern South America, three in New Zealand, two Asiatic. The genus *Hymenodon*, of six species, has two in southern South America, three in Australasia, one in tropical America. *Leptotheca Gaudichaudii* occurs in New Zealand, at the Falkland Islands, and Cape Horn. The genus *Leptostemon* consists of about eight species, two of them in southern South America, five in Australasia, one in Ceylon.

Filices. *Grammitis australis* and *Lomaria alpina* occur in southern South America, Tasmania, New Zealand, and the latter on Kerguelan. The genus *Gleichenia*, mostly confined to the tropics, contains related species in South Africa, southern South America and New Zealand.

Coniferæ. The genus *Araucaria* contains ten species, all South American and Australasian. *Fitzroya Patagonica* occurs in Chile and *F. Archeri* in Tasmania. The genus *Podocarpus* has about forty species, South American, South African, Australasian and Asiatic.

Aponogetonaceæ. *Aponogeton* contains about fifteen species, African, Australian and Asiatic.

Alismaceæ. *Caldisia* with three species in Africa, New Holland and the East Indies.

Centrolepidaceæ. *Gaimardia australis* in southern South America, *G. setacea* in New Zealand.

JUNCACEÆ. *Marsippospermum grandiflorum* in the Magellan region, *M. gracile* in New Zealand.

LILIACEÆ. The genus *Wurmbea* has two species in South Africa, one in Fernando Po, four in Western Australia. *Bulbinella* has ten species in South Africa, one in New Zealand, one in the Auckland Islands. *Bulbine* has twenty-one species in South Africa, two in Australia. *Cœsia* has six Australian species, three South African. *Luzuriaga* contains three species, all of southern South America, but one of them, *L. marginata*, occurs also in New Zealand.

AMARYLLIDACEÆ. The tribe Conantheræ contains four genera, three of them Chilian, the fourth at the Cape of Good Hope.

IRIDACEÆ. The genus *Libertia* has four species in Chili and four in New Zealand and South Australia.

FAGACEÆ. *Nothofagus* contains twelve species, and is confined to southern South America, New Zealand and Australia.

URTICACEÆ. *Australina*, with five species, natives of Australia and South Africa.

PROTEACEÆ. All the genera are austral. According to Engler the species are distributed about as follows: Australia 591, South Africa 262, tropical South America 36, New Caledonia 27, tropical East Africa 25, Chile 7, tropical Africa 5, New Zealand 2, Madagascar 2.

POLYGONACEÆ. The genus *Muehlenbeckia* is confined to Australia, New Zealand, the Pacific Islands and southern South America and the Andes.

MONIMIACEÆ. *Laurelia sempervirens* in Chile, *L. Novœ-Zealandiœ* in New Zealand.

UMBELLIFERÆ. The genus *Azorella* with 30 species distributed in Australia, New Zealand, southern South America and the Andes.

EPACRIDACEÆ. The whole family is Australasian, save one species occurring at Fuegia.

STYLIDEÆ. The genus *Phyllachne* has one species in the Magellan region, three in New Zealand.

In closing, Professor Britton remarked that despite the occurrences cited, and that he had not been able to treat the subject exhaustively, the similarity of the floras was in reality very slight, and that in his opinion it was not necessary to invoke former land connection across the Antarctic region in explanation.

The Terrestrial Invertebrata. By PROF. A. S. PACKARD, Brown University.

In comparing the terrestrial Arctic and Antarctic regions the conditions are most unlike, and literally as wide apart as the Poles. The Arctic regions form a large proportion of the land hemisphere, with a comparatively abundant terrestrial flora and fauna. During the Neocene Tertiary, the arctic land masses were more extensive than now, more continuous, and with little doubt their subtropical life-forms, both plant and animal, constituted an assemblage which sent out waves of migration passing southward and colonizing either side of the American and Eurasian, late Tertiary, continents. The present Arctic and Alpine life, as also the plants and animals of boreal and north temperate Eurasia and America are with little doubt the modified descendants of the Tertiary Arctic regions.

When we pass to the South Pole the conditions are, in the light of our present knowledge, diametrically opposite. The continental Antarctic land masses may or may not be connected. Until 1893 a human being had not landed on the mainland, and even then the ice and snow-clad land revealed only a few lichens, and the rocks a few specimens of Tertiary strata. Not a trace of terrestrial invertebrate life was discovered.

Should, as it is to be earnestly hoped, an Antarctic expedition at no distant day explore the mainland, it may be predicted, judging by what we know of the invertebrate land fauna of Kerguelen Island, that one or two Lumbricoid worms, a terrestrial mollusc, one or two species of spiders, several species of acarina, and of Collembola, a few species of Coleoptera, Lepidoptera and Diptera (including perhaps a mosquito), and possibly some species of parasitic Hymenoptera, will be found to constitute the land invertebrate fauna.

Should any flowering plants ever be discovered, there will probably be added to the list a few of the higher moths, and possibly a butterfly, a bumble bee or two, and a few muscids, which in the high Arctic regions visit flowers. As there are no land birds or indigenous mammals, nor so far as we know any summer migrant birds, such insects if present should abound in individuals, there being no larger animals to reduce their numbers.

We may now proceed to enumerate the terrestrial fauna of Kerguelen Island, the nearest region of whose land invertebrates we know anything.

VERMES. Family Lumbriculidae.

Acanthodrilus Kerguelensis Lankester. (Inhabiting fresh water streams or pools ?)

MOLLUSCA.

Helix hookeri Pfr.

ARACHNIDA.

Myro Kerguelensis Cambridge. Tents numerous under large stones.

Acarus, two species, a red mite on the leaf stalks of the Kerguelen cabbage; and a yellow species abounding on the sides of rocks frequented by cormorants. (Also bird-mites, mallophaga, on marine birds.)

INSECTA. *Collembola.*

Tullbergia antarctica Lubbock, in moss.

Isotoma sp.

Smynthurus sp. under stones.

COLEOPTERA.

Rhyncophora or weevils' six species, also a Staphylinid (*Phytosus atriceps*). These occurred in moss or under stones. Kidder states that "most of the species were incapable of flight, their wing-cases being soldered together." Some of the largest forms were good fliers, however, "the largest and most brilliantly colored specimen taken having flown into my hut one night, attracted by the light." Besides these "little black beetles were caught on rocks near the sea and about the roots of wet tufts of moss." They belong to the genus Octhebius, of the aquatic family Helophoridæ.

LEPIDOPTERA.

Dr. Kidder captured "two lepidopterous insects of moderate size, with very imperfect and abbreviated wings, active in their movements." Mr. Eaton found quite a number of larvæ and pupæ of a small nocturnal moth, remarkable for the extreme brevity of the second pair of wings. He names it *Embryonopsis halticella.*

DIPTERA.

Besides *Musca canicularis* Linn., a cosmopolitan species, six species of flies belonging to new genera, four of which have vestigial wings, are characteristic of this island, and are of peculiar interest.

Dr. Kidder remarks of three of the genera of wingless flies that they counterfeited death when in danger. The carrion feeder (*Anatalanta aptera* Eaton) has no vestige of either wings or balances (halteres).

The leaf feeders (*Calycopteryx mosleyi* Eaton), found on the leaves of the Kerguelen cabbage, resembled large black ants, as they were active in their movements, dark brown, with long legs. The wings are reduced to small scales.

"The third genus (*Amalopteryx maritima* Eaton) was discovered on wet rocks at the edge of the sea. They are provided with small triangular vestigial wings and balancers." They cannot fly, but seem to use the wings in jumping, which they do with great activity, making it quite difficult to catch them. They do not appear to jump in any definite direction, but spring into the air, buzzing the small winglets with great activity, and seem to trust to chance for a spot on which to alight, tumbling over and over in the air. I never observed them jumping when undisturbed.

Dr. Kidder adds that 'the only flying insect observed by me while on the island' (he apparently momentarily overlooked the larger flying weevil) was a small gnat. Mr. Eaton also describes a tipulid (*Halyritus amphibius*) with imperfect or abortive wings.

Of the exact relationship and origin of this restricted island fauna, but little in the present state of our knowledge can be said. To which family the moth belongs I am at present unable to state. As to the Diptera they are mostly muscidæ, and this family is more largely represented in the Arctic regions and on Alpine summits the world over than any other group. But this is not the case with the Coleoptera; of this order the Carabidæ are most numerously represented in Arctic and Alpine regions, and they are common in Chili, while the weevils are the least in number of species in Arctic regions. And yet out of the eight species of beetles inhabiting Kerguelen Island, six are weevils, a group most numerously represented in subtropical and tropical regions. This would seem to indicate that this island was colonized by waifs from the land to the westward, whether from Australia, Africa or South America, I should not dare to say. On the other hand, the land plants and the marine fauna appear to have elements more in common with Patagonia and Fuegia, and this may be explained by the cold polar current which is said to flow from the Antarctic region towards Cape Horn.

Darwin has, in his Origin of Species, called attention to a remarkable feature of the Madeiran Coleoptera, *i. e.*, the unusual prevalence of apterous or wingless species. No less than twenty-two genera which are usually or sometimes winged in Europe having only wingless species in Madeira. Mr. Wallaston discovered that 200 beetles out of 550 species then known to inhabit Madeira are so far deficient in wings that they cannot fly. These facts led Darwin to believe "that the wingless condition of so many Madeira beetles is mainly due to the action of natural selection, but combined probably with disuse. For during many successive generations each individual beetle which flew least, either from its wings having been ever so little less perfectly developed or from indolent habits, will have had the best chance of surviving from not being blown out to sea; and, on the other hand, those beetles which most readily took to flight could oftenest have been blown to sea and thus have been destroyed." On the other hand, the wings of the flower-feeding Coleoptera and Lepidoptera, which are habitually on the wing, 'have, as Mr. Wallaston suspects, their wings not at all reduced, but even enlarged.' He adds that the proportion of wingless beetles is larger on the exposed island Desertas than in Madeira itself. Mr. Wallace, in his great work, 'The Geographical Distribution of Animals' (ii., pp. 211), cites the wingless insects of Kerguelen Island as a remarkable confirmation of this theory.

The poverty of the land fauna of Kerguelen Island, and the reduction in the wings of the insects, are so intimately correlated with the extremely unfavorable climatic condition under which these animals exist that the loss or reduction in the size of the wings may, we venture to suggest, be explained as the result of the direct action of some of the primary factors of organic evolution.

As Dr. Kidder states: "The general aspect of the island is desolate in the extreme. Snow covers all the higher hills. Only along the seashore is a narrow belt of herbage, of which the singular Kerguelen cabbage is at once the largest and most conspicuous component. The weather is also extremely inclement, there being scarcely a day without snow or rain. Violent gales of wind prevail to an extent unknown in the same northern latitude. It was often impossible to go on foot any considerable distance from the home station on account of the severity of the wind. Sir J. Clarke Ross tells of one of his men being actually blown into the sea, and of saving himself from a like accident only by lying flat on the ground." There are no shrubs or trees on the island. The winter season is remarkably mild.

This set of climatic conditions, the continued strong winds, the low temperature throughout the year, and the absence of the sun for the greater part of the year constitute an environment sufficient, we should think, to account for the disuse and resulting atrophy of the wings without invoking the aid of natural selection, unless we allow that the principle may work as a final and subordinate factor. At all events, these agencies and disuse should be the first to suggest themselves, as they are so tangible and easily understood.

Under these conditions the beetles, flies and moths would be driven to seek shelter under stones or by burrowing deep in the damp wet moss. By simple disuse, the wings would begin to atrophy, and after a comparatively few generations become reduced, or in extreme cases almost entirely lost. Certainly the initial cause is the climatic conditions. To these persisting century after century the organism would directly respond, and we do not see the need of evoking the aid of natural selection, ingenious and speculative as it is, any more than in accounting for the loss of eyesight or of eyes, with important parts of the brain, in cave animals, or in deep sea or abyssal forms, we should resort to natural selection. Moreover Darwin himself expressly stated that in the case of cave animals natural selection was not operative. Certainly in the present case disuse due to the direct action of the environment appears to be an efficient, adequate cause.

Vertebrata of the Land; Fishes, Batrachia and Reptiles. By Dr. Theo. Gill, Washington.

Dr. Gill called attention to the discrepancy between the evidence already deduced from the plants and invertebrates and that which would result from the consideration of the higher vertebrates. These discrepancies are in accord with the differences in the geological history of the several classes. For example, all the families of mammals, so far as certainly known, have originated since the commencement of the tertiary; most of the prominent families and very many genera of mollusks still existing, flourished at least as early as the Jurassic and Cretaceous. (The Jurassic fresh-water faunas were especially considered.) Fishes are intermediate between those two types. Naturally, the persistence in duration of the several classes is reflected in the distribution in space. Many families of mammals are confined to special zoögeographical continents, but extremely few families of articulates or mollusks are so limited. In fact, we can avail ourselves of the data furnished by the different divisions for chronometrical purposes; the mollusk answers to an hour hand, the mammal to a minute hand. The fishes yield data for the determination of intermediate points. Remembering these postulates, the evidence given by the distribution of the fresh-water fishes is significant; less so is that of the amphibians and reptiles because they have superior means of locomotion.

There are two families of fresh-water fishes confined to the cold and temperate waters of the southern hemisphere and generally distributed in such ; they are the Galaxiids and Aplochitonids ; the former were associated by the old ichthyologist with the pikes, and the latter with the salmonids, but they really have no such relationship, but are closely related to each other and segregated from all others. The Galaxiids are represented by one genus, *Galaxias*, of which about five species occur in South America, five species in Tasmania, ten species in Australia and five species in New Zealand. (A monotypic genus, *Neochanna*, is confined to New Zealand.) The Aplochitonids number only six species, referable to two genera; of these two are found in South America (*Aplochiton*,) two in Tasmania (*Aplochiton* and *Prototroctes*), one in Australia and one in New Zealand (*Prototroctes*).

It was long supposed that no species of either family of Galaxioidean fishes occured in Africa, but last year Dr. Steindachner described a representative of *Galaxias* (*G. capensis*) and consequently we now have South Africa to consider with reference to a former community of population and continuity of land of all the southern hemisphere.

The conditions of existence and propagation of fresh-water fishes were then discussed and the chances against diffusion of any fresh-water fish across the ocean or by other means than natural water courses were weighed.

In finally taking into consideration the limited distribution northwards and the close relationship of the species of the several regions referred to, it was urged that the evidence in favor of a former Antarctic continental area was strong, and, in view of the affinities of the species of the now distant regions, the conclusion was logical that the time of disruption was not remote in a geological sense. It was suggested that such disruption might have been coëval with the final uplift of the Andes.

The amphibians and reptiles furnish no data bearing directly on an Antarctic continent, but do yield some (though very slight) bearing on an earlier and more northern connection of the southern continents. Much more cogent and less ambiguous is the evidence resulting from the study of the fishes.

The fishes of tropical Africa may be ranked under two grand categories. One of these comprises species of genera or groups represented more largely in Asia, and the other of forms related to types otherwise confined to tropical America. These Afric-American forms belong to the extensive families of Characinids and Cichlids or Chromids. Fishes of these families are the most conspicuous and numerous in both continents. The representatives of the two families of the different continents always belong to different genera, and often to different groups of genera or subfamilies. We have, therefore, in the fishes, as in the mammals, conflicting evidence. According to one set of facts, the continents of Africa and Asia are similar, and, in fact, they have been united to form one zoölogical realm; according to the other the primitive fauna of Africa is more like that of America. Just two decades ago (1875) the speaker explained this apparent contradiction by the assumption that the aboriginal types had been early derived from a common source, and, for that reason, combined Africa with South America and Australia in a zoölogical hemisphere which he named Eogæa, and contrasted with another called Cænogæa, embracing Asia, Europe and North America. The numerous species congeneric with Asiatic and European types, were considered to be recent emigrants, geologically considered. The purport of all the evidence was that there may have been some connection between Africa and South America early in the tertiary epoch. This connection in the present condition of our ignorance of paleontological facts, appears to be more probable than the derivation of the common peculiarities of the faunas of the two continents from a former cosmopolitan fauna or northern areas which have lost them, leaving them to the two southern continents only. The union of Africa with Asia culminated too late to allow of much differentiation of the invading forces that spead over its wide domain.

A former quasi-cosmopolitan fauna was nevertheless manifest in the case of the Ceratodontids, but in Europe and North America they flourished early in Mesozoic times, and none survived later than the Jurassic, and approximately coëval with them were species which lived in India and Africa, but all these died out and the only survivors are the species of *Neoceratodus* of tropical Australia. This family was mentioned as an extreme case of persistence for an osseous fish type.

The amphibians furnish very ambiguous evidence if the accepted taxomy is correct. For example, on the one hand the Cystignathids are well developed and limited to America and Australia, but on the other the Discoglossids are all European, except one genus (*Liopelma*), and that is confined to New Zealand.

The reptiles contribute data looking in different directions. One of the ablest herpetologists of all time has expressed the opinion that 'if a division of the world had to be framed according to the lizard faunas,' the Ethiopian and Palæarctic regions should be combined in one (*Occidental*) and the Australian and oriental in another (*Oriental*), to be themselves aggregated in a realm (Palæogean) differentiated from another (Neogean), comprising the Neotropical and Nearctic regions. Their mode of distribution in fact approximates that of birds, but has been seriously affected by their intolerance of cold and consequently the loss of types, which might be interchanged between the continents. The similarity between the African and Palæarctic regions is doubtless due to the intrusion of forms from the latter into the former. The African, however, has three small families restricted to its area and two shared with America. Quite different is the distribution of the tortoises.

The superfamily of the Pleurodirous or Chelyoidean tortoises is restricted to the southern continents. One family (Sternothærids) is peculiar to Africa, one (Chelyidsé to America and one (Chelodinids) to the Australian realm, while one (Podocnemidids) is common to Africa and America, and another (Rhinemydids) to America and Australia. Except in America these completely replace the fresh water cryptodirous tortoises, but it is noteworthy that species of the terrestrial Testudinids, generally considered as congeneric, occur in all the warm continents except the Australian. It must not be forgotten that formerly (in early tertiary times) the Chelyoideans were represented and, it has been claimed, even by a still existing genus (*Podocnemis*) in the northern hemisphere, and therefore their present occurrence only in the southern continents loses much of its significance. The evidence of former connections of the southern hemisphere furnished by both amphibians and reptiles is indeed of very little account *per se* and is only significant as collateral to that presented by other classes.

To sum up the results of studies of the several classes, the present evidence points to a comparatively recent union of or connection between the southern continents. The inference (independent of the ichthyological data) is based in part on the information respecting the geological duration of mammal families derived from studies of northern strata and in part on the identification of mammal remains of Patagonian strata with Dasyurids, but this evidence may prove illusive. Of some importance in estimating the age is the rediscovery by Mr. Thomas after 20 years of the *Hyracodon* of Tomes and its reference to the supposed extinct family of Epanorthids. This evidence, however, is by no means conclusive. Rather violent assumptions become necessary of remarkable dynamical conditions and the peopling of the said continents by the same type may be hereafter explained otherwise. But in the present condition of our knowledge (or ignorance, if you will), less violent assumptions appear to be called for by the hypothesis that has now been presented than by any other. It must be distinctly understood, however, that it is a hypothesis and a *tentative* hypothesis only. But until it is replaced by a better one or by ascertained facts, the hypothesis will assuredly be useful in directing investigation.

Vertebrata of the Land; Birds and Mammals. By DR. J. A. ALLEN, American Museum of Natural History, New York.

So far as existing mammals and birds are concerned, there seems to be very slight need for calling in the aid of a former Antarctic continent to explain their present distribution. Among mammals the distribution of Marsupials alone gives a hint of a possible former land connection between South America and Australia. The recent discovery (Thomas, Ann. and Mag. Nat. Hist. (6) XVI., Nov. 1895, p. 367) of a form of Marsupial in Colombia belonging to the hitherto supposed extinct family Epanorthidæ, and the occurrence of several distinctly Australian types among the fossil Marsupials of Patagonia, would seem to add much emphasis to this hint. On the other hand, the absence of all other South American types of either mammals or birds from the Australian region, and the presence of the remains of numerous opossum-like animals in the Eocene of both North America and Europe, suggest a possible line of extension by way of the northern land masses without the aid of any former land bridges in the southern hemisphere. Possibly worthy of consideration here is the wide distribution of Mesozoic mammals and the probable Marsupial affinities of at least some of them.

In regard to birds, after excluding wide-ranging types, which have no bearing on the subject in question, there are no groups common to South America and either Africa or Australia. The distribution of the so-called Ratitæ and other flightless birds so often cited as evidence of a former Antarctic continent, has really very little bearing on the question. The so-called sub-class Ratitæ includes, according to the best recent authorities, no less than six orders, of which the South American rheas (Rheæ) form one, and the only one found in the New World; the ostriches of Africa form another (Struthiones), which in Pliocene times ranged as far north and east as southern Europe and India; the kiwis of New Zealand form a third (Apteryges); the cassowaries and emus of the Australian region a fourth (Megistanes); the recently extinct genus *Æpyornis* of Madagascar a fifth (Aepyornithes), and the recently extinct moas of New Zealand a sixth (Immanes). The prevalent notion that all these forms are closely related and must have had a common origin doubtless rests on such superficial resemblances as large size and flightless condition.

Mainly for the same insufficient reason it is the fashion to refer to the Ratitæ such little known extinct forms as *Gastornis* and *Dasornis* of Europe, *Diatryma* of North America, and *Brontornis, Phororhacos, Pelycornis, Opisthodactylus*, etc., of Patagonia. Although some of them appear to have Ratite affinities, others present quite as strong relationship to Carinate types. Most of them are known, however, from such fragmentary remains that little can be said as to their real affinities. Indeed, it is the belief of several eminent authorities that the so-called Ratitæ constitute a very heterogeneous group, the prominent types of which originated independently from perfectly distinct Carinate ancestors. The fact of the occurrence, either still living or only recently extinct, of degenerate flightless forms in such widely distinct Carinate groups as parrots, birds of prey, pigeons, ducks and geese, coots, gallinules and rails, auks, grebes, etc., and that they are in general among the largest members of their respective groups, and also generally inhabitants of islands, shows that mere flightlessness, large size, insular habitat, and an unkeeled sternum are factors of slight importance.

Mr. H. O Forbes in his plea for an Antarctic continent (Antipodea) originally laid great stress upon his discovery at the Chatham Islands of an extinct flightless rail allied to an extinct flightless rail of the genus *Aphanapteryx* found in Madagascar. Indeed, this discovery seems to have been largely the foundation of his original 'tremendous hypothesis,' as Mr. Wallace has called it, of an Antarctic continent. In Madagascar *Aphanapteryx* was contemporary with the dodo, both existing down to about two hundred years ago. The Chatham Island remains were found in kitchen middens of the Morioris, showing that here the supposed *Aphanapteryx* existed to a comparatively recent date. Later examinations by competent authority, however, of the Chatham Island remains has shown that they are not congeneric with *Aphanapteryx*.

It is of interest to note in this connection that some ten genera of flightless Ralline birds are known, three or four of which are still living, while most of the others have become extinct only within historic times. They are all island birds, and nearly all happen to occur in the southern hemisphere, the localities being the islands of Mauritius, Rodriguez, Gough, Tristan d' Acunha, Samoa, Chatham, and New Zealand, but ranging north also to the Moluccas. Furthermore, it happens that they represent all of the leading types of the family Rallidæ, as rails, coots, gallinules and porphyrios, and hence have no very intimate relationship. The fact of their being insular forms thus has not necessarily any bearing on the question of former southern land areas, especially since they are as much tropical and subtropical as austral, and belong to an ancient type of bird life of cosmopolitan distribution. The current belief among ornithologists is that all these forms originated at or near where they are now found from ancestors that could fly. In support of this belief is the fact that one of the earliest marks which distinguish insular forms from their nearest mainland allies and probable ancestors is the reduction of the wings and the corresponding increased development of the pelvic limbs, as is illustrated in the birds of the Guadalupe Islands off the coast of Lower California, and the Galapagos Islands. This change is obviously the result of the new conditions of life—the very limited area to which they are restricted, their sedentary and non-migratory habits, and their comparative freedom from harrassing rapacious enemies.

The Ratitæ and supposed Ratite forms which have so generally been cited in evidence of former connected Antarctic land areas, in reality afford no greater proof of such land bridges than do Carinate birds, when we consider how very distinct are the ordinal groups into which this subclass is divided, and how widely each one is separated geographically from all the others. If we had moas, or ostriches, or kiwis, or cassowaries, or any one of the six orders represented in all three of the present southern continents, or in even two of them, the case would be different. The single order Passeres includes families peculiar respectively to South America, Africa and Australia, which are far more closely related to each other than are the several orders of the Ratitæ *inter se;* yet no one thinks of urging these Passerine groups as evidence of a former Antarctic continent. They are supposed to have originated independently where they are now found and to have never existed elsewhere.

There are, on the other hand, several families of Carinate birds, belonging to different orders, which inhabit the tropical and subtropical regions of both the Eastern and Western hemispheres, but which now and for long ages past have had no possible means of migration from America to Africa, or to India, or to Australia. That the present New World and Old World representatives of these several groups must have had, respectively, a common origin is beyond question; and it is believed to be equally beyond question that they reached their present areas of distribution by the northern land route that formed the means of intercommunication between the northern land masses for so many of the widely dispersed terrestrial forms of life.

Another factor bearing on the general question is the early origin of many of the existing genera of birds, most of the known Pliocene genera still surviving, while many of the Lower Miocene and Upper Eocene genera of Europe and North America are in some cases identical, in others closely allied, to genera still living. Some of them are now restricted to the tropics, but their ranges formerly extended far to the northward of their present limits.

In short, birds afford no clear evidence in favor of the existence of a former Antarctic continent, and mammals only that afforded by the distribution of the Marsupials.

Vertebrata of the Sea. By THEO. GILL, Washington.

On account of the enforced absence of Dr. Goode, detained in Washington by official business, and at his request, Dr. Gill considered the subject assigned to him—the fishes of the sea in relation to the Antarctic continent.

There is really no direct evidence furnished by sea fishes bearing on the question at issue. There are, however, some facts which may throw light on a certain phase of the question. The fishes of the Antarctic seas are very imperfectly known, but the few that are known are of much interest and belong to two very distinct categories.

On one hand, we have a few species belonging to a couple of families only occurring in the extremely cold waters—the Chænichthyids and Harpagiferids. The genera of these families have been referred to the family of Trachinids, but really manifest no affinity to the typical forms of that group. The only inference that appears to be derivable from the two families is that the supposititious Antarctic continent may have been in all Tertiary geological times at least deeply indented by extensions of the ocean far towards the Pole.

On the other hand, in the Antarctic seas recur representatives of genera which have been only found in high northern waters, such as *Myxine*, *Squalus*, and *Merlucius*, and those representatives are so closely related as to have been united in two cases as conspecific. It appears to be most reasonable to postulate for such types derivation from a common source, and that their extension may have been effected in the cold waters of the ocean depths. It is more than possible that, under favorable conditions, species of *Myxine*, *Squalus* and *Merlucius* may yet be found in the cold deep waters below even equatorial seas, for it is to be remembered that all have an extensive bathymetrical range.

Another fact of interest and significance is that there are very few types of Gadids in the Antarctic or cold temperate seas. Their place is taken by representatives of a family of acanthopterygian fishes apparently related to the Chænichthyids and Harpagiferids already mentioned; the Nototheniids, as they are called, are of many closely related species, and in their mode of occurrence and habits appear to be analagous to the codfishes of the north. Their distribution, however, does not throw the least light on the question of an Antarctic continent.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

The *Astronomisches Jahrbuch* for 1898 has just been issued. It is volume No. 123 of the series, and its preparation has been supervised by Dr. P. Lehman, who was placed in temporary charge of the Berlin computing bureau after the death of Prof. Tietjen.

The *Astronomical Journal* of February 17th contains a determination of the elements of the orbit of the binary star F. 99 Herculis, by Dr. T. J. J. See. The orbit obtained is very remarkable because of the fact that the inclination comes out exactly zero. It follows that we see the orbit just as it is, instead of its being projected on the sky with more or less foreshortening. Some uncertainty attaches to this interesting orbit, however, because a former orbit by Mr. Gore and one by Dr. See himself agree in making the inclination more than thirty degrees. H. J.

Nature states that at the last meeting of the Royal Astronomical Society, the Astronomer Royal gave some particulars relating to the progress at Greenwich of the international photographic star catalogue. A special staff for dealing with this work has been organized under Mr. Hollis, and already 130 of the plates taken for the catalogue have been measured. It is estimated that 180 plates can be measured, and 160 of them reduced in the course of a year, so that at this rate the section allotted to Greenwich, comprising about 150,000 stars, will be completed in five or six years. Assuming that the other sixteen coöperating observatories are proceeding equally well, the world will soon be in possession of a colossal catalogue, comprising between two and three million stars.

EXTINCTION OF THE BUFFALO.

Secretary Langley in his annual report, just issued, makes the following appeal for the preservation of the Buffalo in the National Park:

When the Yellowstone Park was organized it was believed that a permanent place of refuge for the buffalo had been secured, and that out of the natural increase of the hundreds then remaining representative herds would be preserved for future generations. It seems now evident that the condition in the Yellowstone region are such that the extermination of the Government herd of buffalo may be anticipated, and that it may be accomplished within a very short space of time. The superintendent of the Park appears not to have adequate means for their protection, and there are on the border plenty of persons whose respect for law is insufficient to keep them from poaching when the prize is a buffalo head or skin which will readily sell for several hundreds of dollars. The temptation to these men seems to be irresistible, and as the herd diminishes, the value of the animals increases and the difficulty of protection becomes constantly greater.

Since, then, the extermination of the Yellowstone herd seems rapidly approaching, something should at once be done, that this may not mean the extinction of the Government control of the species, with the death of the few specimens now in captivity. Only one course suggests itself as completely efficient—transference of the great part of the now few remaining animals to a region where they can be effectively protected and increase normally under natural conditions, in which case the bison need not vanish from the face of the earth. Two years ago there were supposed to be 200 in the Yellowstone Park. The present estimate is one-quarter of that number. The superintendent reports them as being 'constantly pursued,' and in another year there may be none left. If these animals, or a majority of them, can during the next few months be transferred to the National Zoölogical Park at Washington, which affords room and security, they will be safe, and their natural increase in the future can be distributed by exchange with the zoölogical gardens of the various parts of the United States, so that no large city need be without its representatives of the great herds so often referred to in our early history, and now a memory.

GENERAL.

THE *Kansas University Quarterly* announces that a discovery of much interest has recently been made in western Kansas of an extinct species of Bison, the skull having an expanse of nearly four feet. Embedded below the humerus of the skeleton was a small but perfectly formed arrow head. The Bison has not yet been identified with certainty, but seems closely allied to *B. antiquus*, though evidently larger. The formation is apparently the same as that which yielded the skeletons of Platygonus, recently obtained by the University of Kansas. The Bison skeleton, that of a bull, will be mounted shortly in the University museum.

IN the last *Berichte*, G. W. A. Kahlbaum calls attention to the fact that the so-called Liebig's condenser was not devised by Liebig, but by a student of medicine at Göttingen, Christian Ehrenfried Weigel. In his dissertation 'Observationes chemical et mineralogical,' which was defended March 25, 1771, he describes and figures a condenser similar to the ordinary 'Liebig,' except that the upper end of the cooler is open and overflows into a funnel, instead of having a tube to convey away the water. Liebig never claimed to be the inventor of his condenser, but describes it in his 'Handbuch' (1843) as 'der Göttling'sche Kühlapparat,' while Göttling in his 'Almanach' (1794) rightly ascribes its invention to Weigel, who was then professor of botany and chemistry at Greifswald.

THE February number of *Science Progress* contains a translation of Prof. Ostwald's address on scientific materialism of which Prof. Remsen gave a full account in a recent (February 14th) number of this JOURNAL.

GUSTAV FOCK, of Leipzig, offers for sale several valuable libraries including the chemical library of the late Prof. Lothar Meyer. This library contains about 10,000 volumes and dissertations and is offered for sale at the moderate price of M. 7,200.

REV. J. J. THOMPSON has announced a paper to be read before the Royal Society of London on February 13th, on the discharge of electricity produced by the Röntgen rays and the effects produced by these rays by dielectrics through which they pass.

THE *Botanical Gazette* states that the *Pharmaceutische Rundschau* has changed its name to the *Pharmaceutical Review*, and is hereafter to be published chiefly in English, though not to the exclusion of German articles. The veteran editor, Dr. Fr. Hoffmann, retains his connection with the *Review*, but has associated with himself Dr. Edward Kremers, Director of the School of Pharmacy of the University of Wisconsin. The direct coöperation of seven of the leading pharmacists and chemists has been secured, and their names appear upon the title page. The place of publication also changes from New York to Milwaukee, where the Pharmaceutical Review Publishing Co. has charge of all business matters.

TWO yew trees on the new grounds of Columbia College, said to be about one hundred years old and the finest in America, were in the way of the approach to the library and are being moved. The roots have been carefully excavated while the earth is frozen to them. It is curious that these trees were presented to the Bloomingdale Asylum by the trustees of Columbia College when they acquired the Hosack Botanical Garden, which is now the estate from which the College receives a large part of its income.

IT is stated in the last issue of *Nature* (February 13) that "calcic carbide is already made at Spray, North Carolina, at a cost of 20 dollars per ton, by the alternating electric current passed through a mixture of powdered coke and lime. Works have been erected at Niagara which will produce the calcic carbide at 10 dollars a ton, beginning about the middle of this month." This cost seems to be that given by those interested in selling franchises. Some calcic carbide has been made at Spray, but that hitherto used, we believe, has been imported from France and Switzerland and the price quoted in Paris is fr. '25 per kg.—in the neighborhood of $200 per ton. The cost can probably be reduced to $50–100 per ton, and at this price it is said that acetylene would still be cheaper than ordinary illuminating gas or electric light.

THE joint commission of the scientific societies of Washington has adopted a resolution opposing the legislation proposed by Senate bill 1552, entitled 'A bill for the further prevention of cruelty to animals in the District of Columbia;' and urging that in the opinion of the commission the proposed legislation is unnecessary, and would seriously interfere with the advancement of biological science in this District of Columbia.

AT the first ordinary meeting of the London Society of Engineers on February 3d, Mr. S. Herbert Cox, the new President, delivered his inaugural address, which was devoted to a review of the gold mining industry from an engineering point of view, and the developments and improvements in systems of treatment which have been brought about since the discoveries of gold in California in 1848.

THE department of physical geology and mineralogy of the University of Kansas expects to publish about the 1st of April the Volume I. of the University Geological Survey of Kansas, which will be devoted almost exclusively to the stratigraphy of the carboniferous area of Kansas.

THE London *Times* states that the late Mr. Henry Seebohm, who, during his lifetime, was a most liberal benefactor to the natural history branch of the British Museum, has, by his will, left the whole of the ornithological collections in his possession at the time of his decease to the same institution. These have now been transferred from his house in Courtfield Gardens, and are found to consist of more than 16,000 bird skins and 235 skeletons. It is, therefore, one of the most important accessions that this department of the Museum has ever received, especially as it is particularly rich in European and north Asiatic species, the representation of which was hitherto not equal to that of other parts of the world. It comprises a series of almost every known species of game bird, including many rare and costly specimens. The collection of thrushes, a group upon which Mr. Seebohm was preparing a monograph at the time of his death, is the finest ever brought together. Of the wading birds, especially the plovers and snipes, Mr. Seebohm had already presented many hundreds of specimens, but the 1,140 skins which he retained in his possession until his death comprised the best of his collection and formed the material upon which he founded his great work on the geographical distribution of the group. Besides the many types contained in the collection, and large series from localities whence the Museum had not hitherto had the opportunity of obtaining specimens, there are also many historical collections, such as Swinhoe's Chinese birds, Pryer's Japanese birds, Anderson's Indian birds, a nearly perfect set of the birds of Mount Kini Balu in Borneo, and the invaluable series obtained by Mr. Seebohm himself in the Petchora and Yenisei Valleys.

THE Secretary of the Interior has approved and forwarded to Congress the recommendation of the Commissioner of Education that $45,000 be appropriated this year for the purchase of reindeer, to be distributed among the missionary stations and white settlements of Alaska.

ACCORDING to the *Lancet* 199 medical journals are published in Paris, the number having been increased by 22 journals during 1895.

THE editorial staff of the *Journal of Comparative Neurology* has recently been increased by the addition of Dr. Oliver S. Strong, of Columbia College. Prof. C. L. Herrick is editor-in-chief as hitherto. Business communications should be addressed during 1896 to the managing editor, C. Judson Herrick, at Denison University, Granville, Ohio. Editorial communications may be sent to any one of the three editors.

Garden and Forest states that, on the 5th of February, Mr. Frank H. Nutter read a paper at Taylor's Falls, Minnesota, in which, after discussing in a general way public parks and reservations, with their history and treatment, he gave a preliminary report on the proposed interstate park at the Dalles of the St. Croix, where something like four hundred acres of land, partly in Minnesota and partly in Wisconsin, have been acquired as a public reservation. The Falls proper are not high, but the Dalles, with their lofty and precipitous rocks on either side, stained with brilliant colors from oxides of copper, or painted with Lichens and Moss, make a most interesting passage of natural scenery.

CHRISTOPHE NEGRI, the Italian economist and geographer, died in Florence on February 18, aged 86 years.

DR. ZELLE, of Brandenburg, has exhibited before the Emperor of Germany specimens of his work in photographing in colors.

THE House Committee on Military Affairs has heard arguments in support of the bill of Mr. Fairchild, of New York, appropriating $500,000 for the establishment of a national military and naval park embracing the Palisades on the Hudson River.

GINN & Co. will publish at once, in their 'Classics for Children' series, *White's Natural History of Selborne*, edited, with an introduction and notes, by Prof. Edward S. Morse.

THE New Jersey Library Association met at Newark, January 30th. The main topic was the relation of the State to libraries, with a view to establishing a New Jersey Library Commission. The two plans chiefly discussed were those of Massachusetts and of New York with its system of traveling libraries. The Massachusetts plan was presented by S. S. Green, of the State Commission, and that of New York by W. R. Eastman, Library Inspector.

ACCORDING to the *British Medical Journal* the Orphanage School of St. Margaret's, in the town of East Grinstead, has been recently visited by diphthera; two of eleven cases proved fatal. Every method was adopted for ascertaining the predisposing cause of the outbreak, but with no success so far as the buildings were concerned. But at length the health officer had the drains outside the institution exposed, when he found that the house drain in its length of communication with the sewer crossed the playground; this length was in a most deplorable state. The communication pipe was only a few inches below the surface, was an old land drain, uncemented at the joints, and these gaping an inch or two; the surrounding soil, whereon the children played, was saturated with sewage. The matter was, of course, put right, but only after human life had been sacrificed, and many children had been sufferers. Moreover, the school inmates had for some time prior to the outbreak been noticed as looking pale and ill, the result, no doubt, of constantly playing in so unhealthy a situation.

IN notes presented before the Paris Academy of Sciences, on January 27th and February 3d, M. Gustave Le Bon claimed that he had demonstrated by photographic effects that ordinary sunlight and lamplight are transmitted through opaque bodies, and states that the body might be a sheet of copper 0.8 mm. in thickness. His experiments have however been questioned by M. Niewenglowski, who states that he has obtained the same effect in complete darkness, and attributes them to luminous energy stored up in the plates.

The Physical Review for March-April will have among the principal articles ones on the Viscosity of Salt Solutions by B. E. Moore; on the the Theory of Oscillating Currents by Steinmetz; on Induction Phenomena in Alternating Currents Circuits by F. E. Millis; on the Magnetic Properties of Cylindrical Rods by C. R. Mann, and a Photographic Study of Arc Spectra by Caroline W. Baldwin. There are several interesting Minor Contributions and a number of Book Notices.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT JOHN M. COULTER has resigned the presidency of Lake Forest University to become head professor of botany in the University of Chicago. It is understood that part of the money recently given to the University by Miss Culver has been used to endow this chair.

PRESIDENT ELIOT has for some time advocated the reduction of the collegiate course of Harvard University from four to three years. The *Boston Transcript* states that at a recent meeting of the Harvard faculty an informal vote on the proposition showed fifty in favor of the plan and thirty-five against it. Several years ago the faculty formally approved the plan of reducing the number of courses necessary to a degree from eighteen to sixteen, but it was rejected by the overseers.

CONVERSE COLLEGE established about five years ago at Spartanburg, S. C., has received a gift of $70,000 from Mr. D. E. Converse, together with $30,000 given by the citizens of Spartanburg, S. C.

AT a meeting of the Council of the University of the City of New York, the University medical faculty reported in favor of extending the course for degrees of doctor from three to four years. The Council approved a plan for a College Close which includes an inner court measuring about 250 feet in width by 300 feet in length. Fronting upon this, five residence halls and a dining hall will be built.

DISCUSSION AND CORRESPONDENCE.

KEW'S DISPERSAL OF SHELLS.

EDITOR OF SCIENCE: In the review of Kew's *Dispersal of Shells* by Dr. Packard, the reviewer points out certain omissions which could not have been overlooked by Mr. Kew if he had taken the trouble of consulting either Gould or Binney in the original. For a volume of the International Series the book is amazingly provincial. I do not wish by this expression to gainsay its value; it is an exceedingly valuable collection of notes, memoranda and isolated items referring more particularly to the dispersal of shells in England. Dr. Packard has inadvertently overlooked a very important omission in there being no reference to the dispersal of Litorina litorea from its centre at Halifax, Nova Scotia (where it was first introduced from the other side of the Atlantic) along the shores of the Bay of Chaleur, and southward to New York and beyond. In Science News for 1879 Mr. Arthur F. Gray called attention to the successive occurrence of this species as it spread southward along the coast. Professor Verrill in the American Journal of Science, for Sept., 1880, records his observations regarding the dispersion of this species. In the Essex Institute Bulletin for 1880, in a paper on the Gradual Dispersion of Certain Mollusks in New England, I presented a map of the New England coast and upon this was marked chronologically the dates of the appearance of this large and conspicuous mollusk as it found its way south. In this paper I showed what a barrier Cape Cod offered for some years. My last find was at Glen Cove, Long Island. In the same paper I called attention to the dispersion of Pupa muscorum (badia, of Adams) from its first place of observation in Vermont, into various parts of New England. I think Binney was wrong in believing that Helix hortensis was introduced into New England since the advent of the European. I have discovered Helix hortensis on islands in Casco Bay, buried in the lowest deposits of shell heaps containing bones of the Great Auk. The occurrence of this species in such positions could not be accounted for by supposing that the creature had burrowed down to the lowest level of the deposits, for the mass was too compacted to admit of this explanation. I have found them under stones resting on the primitive surface of the ground associated with other species found only in hard wood growths, and now coniferous trees only abound in these places. It is certainly extraordinary that this species is only found living on the outer islands of New England—its habits being entirely different in this respect from its English relative.

EDWARD S. MORSE.

SALEM, February 18, 1896.

'SCIENTIFIC MATERIALISM.'

EDITOR OF SCIENCE: A few remarks on the article 'Scientific Materialism' in SCIENCE, February 14th, may not be out of place.

It seems a case of 'reversion' to speak of 'energy' as something distinct from force, or rather from definite forces. Energy apart from force is inconceivable. To quote Lewis' example, we might as well speak of 'cellarity,' as something apart from cellars!

The definite forces with which science deals are, as every one knows, simply modes of motion. Hence Helmholtz, Tait, Romanes and most modern students have regarded matter, atoms, molecules, all as but expressions of motion, and to be analyzed by the three primary laws of motion and the theorems derived from them. Of course this leads inevitably to a strictly mechanical conception of phenomenal existence.

That the mathematics of mechanics is at present inadequate to solve all the problems offered is simply because, as Whewell pointed out, the procedures of mathematicians do not yet furnish the necessary apparatus. But to say (as on p. 225) that 'the mechanical conception of heat has not been confirmed;' in the face of the latest treatises on thermo-dynamics, based throughout on the laws of motion, is an inexplicable assertion.

The 'way out' of scientific materialism is not by the assumption of an entity apart from attributes; but by the indisputable truth that the laws of mechanics and motion themselves are in final analysis nothing else but laws of thought, of the reasoning mind, and derive their first and only warrant from the higher reality of that mind itself. D. G. BRINTON.

THE RÖNTGEN RAYS.

PROF. RÖNTGEN concludes his paper *On a New Kind of Rays* by showing that they behave quite differently from the visible, the infra-red and the hitherto known ultra-violet rays, and by suggesting that they should be ascribed to longitudinal waves in the ether. He does not, however, indicate how longitudinal waves would account for the phenomena, and probably most readers of his paper have not seen any evident connection between longitudinal vibrations and the behavior of the Röntgen rays. Prof. R. S. Woodward has, however, called the writer's attention to a fact which Prof. Röntgen does not mention, but which may have been present in his mind. If there be longitudinal waves in the ether they must travel with much greater velocity than the transverse waves. Would not this greater velocity account for the absence (partial or complete) of reflection and refraction, and for the penetration—even the fact that this tends to be inversely proportional to the density of the substance? J. McK. C.

CYCLONES AND ANTI-CYCLONES.

TO THE EDITOR OF SCIENCE: In connection with the diagrams published by Prof. Davis in a recent issue of SCIENCE (N. S. Vol. III., p. 197), showing the circulation of the wind and cirrus clouds in cyclones and anti-cyclones, it seems to me a few words should be added in regard to the method by which the results were obtained. Åkerblom, following Hildebrandsson, found the mean directions of the wind and clouds for different directions and intensities of the barometric gradient as observed at the earth's surface and then drawing concentric circles plotted the results around a central area. This method is not the same as finding the relation of the wind and cloud movements to the centers of cyclones and anti-cyclones. A given gradient is sometimes very near the center of a cyclone or anti-cyclone, at other times far removed from it, and again there may be no well-defined cyclone or anti-cyclone, but merely what are called straight isobar gradients.

At Blue Hill I have found considerable differences between the directions and velocities of the upper currents near to and at a distance from the centers of cyclonic and anti-cyclonic action, and it leads me to the conclusion that mixing together observations made at the two points can only lead to confusing results.

The results of Åkerblom for central Germany by no means agree with the results of Dr. Vettin for Berlin as regards the movements of the cirrus in anti-cyclones. Dr. Vettin found the average movements of the cirrus in relation to the direction of the center of the anti-cyclone, and his results agree remarkably well with those found at Blue Hill. (Amer. Meteor. Jour., Vol. X, p. 172.)

H. HELM CLAYTON.

BLUE HILL MET. OBSERVATORY, Feb. 10, 1896.

SCIENTIFIC LITERATURE.

A Handbook to the British Mammalia. By R. LYDEKKER. Allen's Naturalists' Library, edited by R. Bowdler Sharpe. 8°, pp. 339, col. pls. and text figs. London, 1895. 6 shillings.

From early times the British Mammalia have received a large share of attention. Beginning with Thomas Pennant's British Quadrupeds, in 1786, we have: Memoirs of British Quadrupeds (including a Synopsis), by the Rev. W. Bingley (1809); Natural History of British Quadrupeds, by Edward Donovan (1810–1820); Recreations in Natural History, or Popular Sketches of British Quadrupeds, by W. Clarke

(1815-1819); a History of British Quadrupeds, by Thomas Bell (1837); British Quadrupeds, by W. Macgillivray (Jardine's Naturalist's Library, 1838); a new and revised edition of Bell's British Quadrupeds (1874); British Animals extinct within Historic Times, by James E. Harting (1880); and now, A Handbook to the British Mammalia, by R. Lydekker (1895). The present work differs in scope from any of its predecessors inasmuch as it treats of both the living and the extinct species.

The author states in his preface that he makes no claim to personal knowledge of the habits of British mammals, but has drawn largely on Macgillivray's 'Manual,' of which work the present 'may be regarded almost as a new edition.' The principal differences are that Mr. Lydekker has rewritten the whole of the technical matter, has brought the geographic distribution and nomenclature down to date, from his standpoint, and has added a dozen pages of introduction. In the matter of nomenclature the earliest specific name is adopted when it does not happen to be the same as that of the genus in which it is included. On this point American naturalists will be pleased to read the following, from the prefatory note by the able editor of Allen's Naturalist's Library, Mr. R. Bowdler Sharpe. Mr. Sharpe says "I feel convinced, however, that the absolute justice of retaining every specific name given by Linnæus will some day be recognized. Thus, in my opinion, the correct title of the Badger should be *Meles meles* (L.); of the otter, *Lutra lutra* (L.); of the Roe-deer, *Capreolus capreolus* (L.); of the Common Porpoise, *Phocæna phocæna* (L.); of the Killer, *Orca orca* (L.)."

The illustrations are the same as those in the original edition of Macgillivray, which formed the 22d volume of Jardine's Naturalist's Library (1838). They are cheaply printed, without attempt at fidelity of coloring, and differ from the originals in having the foregrounds, as well as the animals, colored. The original skull outlines also are retained, though for what purpose one can hardly imagine, since in most cases it would be difficult, if they were not so carefully labeled, to tell the family to which they belong.

The feature of the British Mammal fauna that strikes the naturalist with greatest surprise is its paucity in species. In his introduction Mr. Lydekker says that, excluding introduced species, only 41 terrestrial mammals 'can be regarded as indigenous inhabitants of Britain during the historic period,' and five or six of these are now extinct; hence the total number of indigenous mammals now living in England, Scotland, and Ireland together is not more than 35 or 36, and the number inhabiting Ireland is only 19. The contrast with any equal area on the continent of Europe or America is striking. For instance, the single State of New York contains at least 53 indigenous land mammals. The explanation of the small number of species in the British Islands is that the early fauna was largely exterminated during the glacial epoch, and the species have not been able to reach the Islands since. This explanation is rendered the more probable by the fact that a dozen of the present mammalian inhabitants are bats—animals that could easily cross the channel—thus reducing the number of truly terrestrial species to a couple of dozen.

The most extraordinary statement I have observed in the book is that the common shrew spends the cold months 'in a state of profound torpor' (p. 78). So far as known, none of the shrews hibernate; on the contrary, they remain active throughout the longest and coldest winters, and even in the far north scamper about on the snow when the temperature is many degrees below zero.

The book as a whole, while lacking the multitude of detailed observations so valuable to the local field worker, is nevertheless a welcome addition to mammal literature and will prove a useful work of reference for many years to come. The closing chapter on 'The Ancient Mammals of Britain' is the most important of all.

C. H. M.

The Cambridge Natural History, Vol. V., Peripatus. By ADAM SEDGWICK, M. A., F. R. S., Fellow and Lecturer of Trinity College, Cambridge. *Myriapods,* by F. G. SINCLAIR, M. A., Trinity College, Cambridge. *Insects, Part I.,* by DAVID SHARP, M. A. (Cantab.), M. B.

(Edinb.), F. R. S, London and New York, Macmillan & Co. 1895. 8°, pp. xi+584, and 371 wood cuts. $4.00.

This volume of the *Cambridge Natural History* bears upon its cover the subtitle *Peripatus, etc., Sedgwick;* from which one gains no hint that the book consists chiefly of the first part of an extensive treatise on Insects by David Sharp. But such is the case, more than five-sixths of the volume being on this subject and by this author.

The volume is begun by an essay on *Peripatus* by Adam Sedgwick, the well-known authority on this genus. This essay, which gives the title to the volume, comprises only 24 pages; but it contains a very clear account of the structure, habits and development of these, the most generalized of all arthropods. To this account are added a synopsis of the known species and a map illustrating the geographical distribution of the genus.

Following the essay on *Peripatus* is one treating of *Myriapods* by F. G. Sinclair. This occupies about 50 pages of the volume. After a somewhat rambling introduction, there is given a brief synopsis of the orders and families of this class, based chiefly on the classification of Koch. This is followed by an excellent account of the structure of Myriapods, including a discussion of the distinctive features of each of the four orders, an outline of the embryology of these animals, and a résumé of our knowledge of fossil forms.

The chief interest in the volume, however, centers in the portion written by Mr. Sharp. During the last few years, in this country at least, there has been a great increase in the number of students of insects; and any work on this subject from the hand of a master is sure to be warmly welcomed. In this case the welcome will not be soon worn out. *Sharp's Entomology*, as this and the succeeding volume should be termed, will find and keep a place on the desk of every working entomologist; for, judging by the part before us, this is the best general treatise on insects that has yet appeared in any language.

The great merit of the work lies in the clearness and simplicity of its style, in the excellence of the illustrations, in the extent to which recent contributions to the morphology of insects are included, and in the numerous bibliographical references.

In the division of the Insecta into orders, a conservative plan is followed, only nine orders being recognized; but most of the smaller orders of recent writers are indicated by subheadings. The following is a list of the orders recognized: *Aptera, Orthoptera, Neuroptera, Hymenoptera, Coleoptera, Lepidoptera, Diptera, Physanoptera* and *Hemiptera.*

The resurrection of the old name *Aptera* and its application to the order now almost universally known as the *Thysanura* seems to me to be unfortunate. The advantage of retaining the termination 'ptera' for each of the orders, which seems to be the main reason for this course, could have been attained by the adoption of Brauer's term, Synaptera, which is of the form desired, is not in itself misleading, and has not been used in a widely different sense, as is the case with Aptera.

It seems strange too, in the light of recent contributions on the subject, that our author, in his linear arrangement of the orders, should separate so widely the Trichoptera (included by him in the Neuroptera) and the Lepidoptera; certainly these groups have been shown to be more closely allied than any other two of the nine orders.

But criticisms of details in a brief notice of so important a work as this are hardly worth while. It is enough to say that the plan of treatment is excellent, and that it has been carried out in an admirable manner. Entomologists will eagerly await the appearance of the concluding volume.

JOHN HENRY COMSTOCK.

The Herschels and Modern Astronomy. By AGNES M. CLERKE. Published by Macmillan & Co., New York. Pp. vi+224, with three portraits. Price, $1.25.

For this volume, considered as biography, we have nought but praise. In smoothly flowing lines its author gives, not the annals of the Herschel family, but rather a series of pictures from the lives of Sir William, Sir John and Caroline which suffice to present in vivid colors the individuality of brother, sister and son. We catch a glimpse of the German lad bred to music as a trade and penury as a condition of life, and are hurried along to another glimpse of the fashionable organist of Bath who has risen to the dignity of professional life, who cultivates the sciences as an amateur and, what is more to the purpose, who has become an Englishman by adoption.

We encounter here the clue to William Herschel's success in life, an ardent temperament coupled with an insatiable greed for knowledge and tireless activity in its pursuit. From one point of view it is proper enough to describe as a lucky accident the discovery of Uranus which transformed the amateur into the professional astronomer, supplied by royal favor with opportunity, which it would be mockery to call leisure, for the building of telescopes and their use in explorations of the heavens. But such a characterization of the turning point in William Herschel's career is less than half the truth, and it is the province of his biographer to insist that zeal and diligence such as his make circumstances and constrain luck to follow them.

We shall not pursue the career which rising from humble beginnings culminates in the presidency of the Royal Society, and closes at the end of a long lifetime with perhaps a suggestion of waning enthusiasm coupled with broken bodily powers. Nor can the career of Caroline, all too briefly told, detain us for more than a glance at its simple loyalty and devotion to her brothers' plans in life, a devotion whose dignity is given a tinge of mingled pathos and humor by her own words anent the reluctant change of vocation from music to astronomy: "I have been throughout annoyed and hindered in my endeavors at perfecting myself in any branch of knowledge by which I could hope to gain a creditable livelihood."

The career of Sir John Herschel, marked though it be with brilliant talents and high achievements, conveys nevertheless a sense of disappointment. The father's steadfastness of purpose was lacking in the son, and we confess to a feeling of regret that the telescopes, great and small, which furnished work for his early manhood were laid away in middle life, never again to be seriously used. Whether Sir John's successive inclinations to mathematics, to the bar, to astronomy, chemistry, physics and political office shall be called versatility or vacillation perchance depends as much upon the critic's mood as on aught else, but we cannot doubt that however they be named they were a limitation upon the achievement possible to any talent placed as was his at the beginning of the era of specialization.

With that part of the author's work which sets forth the relation of the Herschels to modern astronomy we are less pleased, and we opine that no injustice is done in characterizing the spirit of her pages with the maxim of political strife, 'Claim everything! Claim it with confidence!' The contributions of the Herschels to modern astronomy are unquestionably great, but they did not build the entire edifice nor even lay all of the foundations. "The powers of the telescope were so unexpectedly increased that they may almost be said to have been discovered by William Herschel." "He made the first attempt to lay down a definite scale of star magnitudes." "Herschel was in the highest and widest sense the founder of sidereal astronomy." "All modern efforts to widen telescopic capacity primarily derive their impulse from Herschel's passionate desire to see further and to see better than his predecessors." Such are samples of what we must consider exaggerated pretentions which may be pardoned in an obituary discourse, but not in a critical estimate of the lines of development of modern science.

Nor is the author altogether free from slips upon the technical side of her subject. Thus if 'a one-inch glass actually quintuples the diameter of the visible universe, it gives access to' one hundred and twenty-five times, and not to 'seventy-five times the volume of space ranged through by the unassisted eye.' But it may well be doubted if the relation itself is not wholly fallacious. Nor is it true that 'the whole system of micrometrical measurements came into existence through Herschel's double-star determinations.' Gascoign, Auzout, Rœmer and probably others used the filar micrometer before Herschel's time, if not in his manner. So also we may be permitted to doubt whether most of the double star orbits at present known have been calculated by the method of Sir John Herschel since the method has distinctly fallen into disfavor.

Hostile criticism might easily select other and similar matter for adverse judgment, but much as the book is thus disfigured it remains well worth the writing and the reading thereof.

One feature remains which should not be left unnoticed, since in some measure it serves to correct false impressions elsewhere produced. The active and fecund imagination of William Herschel called into existence a swarm of fancies and hypotheses, some of which have become integral parts of the fabric of modern astronomy, while others have been consigned to the intellectual rubbish heap. Types of each class, the failure as well as the success, are presented to the reader, who, without the light which they cast upon the mental characteristics of the man, might well cry out, here is no flesh and blood, but a demi-god set to unravel the universe.

G. C. C.

SCIENTIFIC JOURNALS.

THE JOURNAL OF COMPARATIVE NEUROLOGY. DECEMBER, DOUBLE NUMBER.

On the Brain of Necturus maculatus. By B. F. KINGSBURY. A monograph of 65 pages, accompanied by 3 plates, gives the results of the application of the newer methods of staining to the difficult subject of the amphibian brain. The following points are selected from the summary:

1. As compared with certain smaller urodeles, the brain of Necturus is greatly elongated. This appears to be due largely to a greater inequality between the rates of growth of the brain and skull. This is shown, it is thought, especially by (*a*) the almost entire absence of a pons flexure, (*b*) the length of the olfactory nerves, (*c*) the extent of the diatela.

2. A callosum is considered to be entirely absent in the amphibian brain; what has been generally regarded as such is here thought to be a hippocampal commissure, in part at least, although the homology should be dependent on comparative study.

3. An olfactory tract upon the extreme ventral surface of the cerebrum may be traced to the region just caudad of the infundibulum, presumably the region of the albicantia.

4. The paraphysis is well developed and in communication in the adult with the encephalic cavities. The postparaphysis of some authors is not regarded as a true evagination.

5. The ental origins of the cranial nerves are worked out more less completely. For general results reference may be made to tables on pages 179 and 191 of the text. In particular, the motor portion of the facial nerve is shown to have the same mode of origin as in the majority, at least, of vertebrates. The first two roots of the vago-glossopharyngeal group, stated to be the representative of the lateral nerve of 'fishes,' and the nerve termed 'dorsal seventh,' are composed of fibers of the same appearance and terminate in the dorsal region of the oblongata in the neighborhood of the eighth nerve.

6. Mauthner fibers were demonstrated in the adult *Necturus*, *Amblystoma* and *Diemyctylus*. *Amblystoma* is a land form, hence there is no direct correlation with an aquatic mode of life.

7. Myelinic nerve fibres from the mesencephal pass to the ectal surface of the brain immediately ventrad of the epiphysis; these may possibly represent a parietal nerve.

The Cortical Optical Centres in Birds. By DR. LUDWIG EDINGER.

Dr. Edinger is continuing his interesting studies on the phylogeny of the cerebral cortex. He has previously maintained that the olfactory nerve is the first to effect cortical connections and that the cortex of the Ichthyopsida is exclusively olfactory in function. He now finds in the birds a tract which he names the tractus occipito-tectalis, which puts the optic nerve into similar relations with the cortex. This tract becomes medullated some weeks after hatching, exactly as in the mammals, where it has the same termini. The appearance of this tract he correlates with the remarkable visual powers of birds.

In an editorial note Prof. Herrick criticises Dr. Edinger's position with reference to the evolution of the cortex. In particular he differs from Dr. Edinger's opinion that the olfactory function is the only special sense which enters the psychic life of infra-avian vertebrates, but believes that we have evidence that reptiles also have their optic associations. In fishes even he has already demonstrated an indirect connection between the optic tectum and the axial lobe, which latter must be regarded as functionally and probably morphologically equivalent to the cortex of the higher forms.

In a second editorial Prof. Herrick discusses *Neurology and Monism*. He advocates a *dynamic monism* which stands in strong contrast with the analytical monism of Lloyd Morgan, as presented especially in his recent work on Comparative Psychology. Interesting applications are hinted at in the field of algedonics.

The concluding sixty pages of the number are devoted to book reviews and the bibliography of the half-year past.

SOCIETIES AND ACADEMIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, JANUARY 7, 1896.

DR. BENJAMIN SHARP made his second communication on the ethnology of Alaska and Siberia, based on collections made by him the past summer during the cruise of the U. S. Revenue Cutter 'Bear.' He described a large collection of instruments, weapons and household utensils and exhibited a number of lantern illustrations.

A minute of the Academy's appreciation of the clearness of judgment, knowledge of affairs and courtesy of personal intercourse which had been the characteristics of the administration of the retiring President, General Isaac J. Wistor, was adopted.

JANUARY 14.

A paper entitled 'New Species of the Halicoid Genus Polygyra,' by Henry A. Pilsbry, was presented for publication.

MR. HENRY A. PILSBRY exhibited and described a specimen of Pleurotomaria from Mullica Hill, N. J. It resembles P. solariformis and P. perlata, but is much more discoidal and is probably the imperfectly described P. crotaloides of Morton.

JANUARY 21.

Papers under the following titles were presented for publication: 'Descriptions of New Species of Mollusks,' by Henry A. Pilsbry; 'The Molting of Birds, with special reference to the Plumages of the Smaller Birds of eastern North America,' by Witmer Stone.

MR. EDW. GOLDSMITH described a peculiar crystallization as the result of long-continued evaporation of solutions of Iodide of Potassium. The crystalline form is hexagonal and resembles that which has been obtained from kelp liquids.

PROF. EDW. D. COPE exhibited and described the remains of fossil Balænidæ, of which he had determined sixteen species from the Neocene of Maryland, Virginia and North Carolina. The ear bones of an apparently undescribed Balænoptera and of a Balæna, apparently identical with affinis, were also described.

A resolution was adopted urging on the attention of the Smithsonian Institution the desirability of continuing the rental of a table at the Naples Zoölogical Station for the benefit of American students of biology.

JANUARY 28.

A paper entitled 'Contributions to the Zoölogy of Tennessee, No. 3, Mammals,' by Samuel N. Rhoads, was presented for publication.

The newly elected President, Dr. Samuel G. Dixon, resigned the professorship of histology and microscopic technology in consequence of increase of executive duties.

DR. BENJAMIN SHARP continued his communication on the ethnology of Alaska, based on collections made by him during last summer's cruise of the U. S. Revenue Cutter 'Bear.'

In continuation Dr. D. G. BRINTON spoke of the supposed influence of Asiatic emigration on the primitive civilizations of America. Reviewing the subject as illustrated by languages, myths, industries, arts and physical characteristics of the tribes, he expressed the belief that there was no reason to suppose that any such influence had been exerted. He was aware that in holding this belief he stood almost alone among American ethnologists, although his views were in harmony with those of some of the best European authorities.

A special committee of the Entomological Section of the Academy reported a mode of exterminating the tussock moth, Orgyia leucostigma, with which the trees of the city streets and squares are so badly infested.

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FEBRUARY 4.

PROF. CARTER, of the High School, described a tree about eighteen feet long and ten inches in diameter from ten feet below the surface of a sandstone quarry in Montgomery county, Pa., which had been turned into iron. The Hæmatite had been entirely leeched out of the sand in the vicinity of the tree.

MR. F. J. KEELEY described the characters of a microscopic preparation of jade. It was of interest in connection with the ethnological discussion at the last meeting, as Dr. Brinton believed that American jade could be distinguished from the Asiatic mineral by its microscopic characters.

FEBRUARY 11.

A letter was read from Dr. Karl A. von Zittel, expressing in complimentary terms his gratification at the action of the Academy in conferring upon him this year the Hayden Memorial Geological Award.

Papers under the following titles were presented for publication: 'The Earliest Record of Arctic Plants,' by Theodore Holm; 'A Note on a Uniform Plan of describing the Human Skull,' by Harrison Allen.

PROF. COPE exhibited and described a portion of a cetacean cranium from the Neocene beds of the western shore of the Chesapeake Bay. For a whalebone whale, which it probably was, the frontal and parietal bones are of an unusual character. The presence or absence of dentition had not been determined. The specimen indicated a new genus and species for which the name Metopcetus durinasus was proposed.

EDW. J. NOLAN,
Recording Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 255TH MEETING, SATURDAY, FEBRUARY 8.

F. V. COVILLE exhibited specimens of a poisonous cactus *Anhalonium Lewinii* from Ensinal Co., Texas, stating that the tops were sliced and dried and used by the Indians as an intoxicant and stimulant during their religious dances. The cactus was a spineless species and its poisonous juice was apparently for protection.

CHARLES L. POLLARD exhibited a specimen of a desert milkweed, *Asclepias albicans* and commented on its adaptation to desert conditions.

DAVID WHITE exhibited specimens and spoke at some length on '*Some New Forms of Palæozoic Algæ from the Central Appalachian Region.*' For one of these a delicate ribbon-like dichotomous and spirally-twisted organism, which seemed unique in some respects, the new generic name *Spirophycus* was suggested. Another form, which, like the preceding, was found near the top of the Lower Carboniferous along New River, W. Va., seemed to belong to the group of Devonian Algæ for which Pantallon in 1893 revived Brongniarts genus *Dictyotites.* But this name having long ago become a synonym, was rejected by the reader who proposed to substitute for Dr. Penhallow's group the name *Dictyotopsis.*

Charles L. Pollard read a paper entitled '*Observations on the Flora of the District of Columbia,*' and enumerated a list of 17 plants new to the Washington flora, in addition to those recorded in a previous paper by Mr. Holm. About one-third of these consisted of weeds introduced in ballast or cultivated grounds; an equal proportion contained stray escapes from cultivation chiefly in the public parks, while the remainder comprised species hitherto overlooked or possibly actual accessions to the flora. The author also commented on the structure and relationship of the anomalous *Phacelia Covillei*, giving the views of various botanists upon the species, and showing the proposition that it is a hybrid between *P. parviflora* and *Macrocalyx nyctelea* to be untenable.

F. A. LUCAS,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE Philosophical Society of Washington held its regular meeting on February 15th, at which the following papers were presented:

An *Expedition to Seriland*, by W J MCGEE.

The *Thermophone*, by A. M. RITCHIE, of Boston.

This is a new instrument for measuring temperatures. It is an electrical thermometer of the resistance type, using two resistance coils of different metals. The description was illustrated by an exhibition of the instrument itself.

W. J. DALL described *Some Characteristics of the Genus Spirula.*

J. HOWARD GORE read a paper on *The Groningen Land-lease System*, being one of perpetual lease to tenants and heirs. Groningen is one of the most prosperous provinces of the Netherlands.

BERNARD R. GREEN,
Secretary.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE New York Section of the American Chemical Society held its regular meeting at the College of the City of New York on Friday evening, the 7th inst.

The programme announced a paper by Dr. R. G. Eccles on 'New Facts about Calycanthus,' and 'Items of Interest from the Cleveland Meeting,' by Prof. A. A. Breneman.

Dr. Eccles stated that the calycanthus seeds, on which his work had been done, were from Tennessee, where they were considered as being poisonous.

He had separated from them an alkaloid different from and more peculiar than any alkaloids known to chemists.

The seeds contain one-third their weight of a bland, pale yellow fixed oil. This oil is wholly removable by petroleum ether. When freed from oil and placed in water the seeds ferment, and the separated alkaloid gives the following reactions: Green color, by strong nitric acid. Pale canary, by hydrochloric acid. Red, by sulphuric acid and bichromate of potash.

Heated with strong caustic potash, a new alkaloid was developed and a sweetish odor produced.

Dr. H. W. Wiley had also examined the seeds, and had found that the alkaloid produced a fine purple color with cane sugar and sulphuric acid. The seeds themselves contain enough sugar to give this reaction. A single seed beaten up with a few drops of water yields the fine purple color on addition of a drop of sulphuric acid.

Ether alone will only extract a trace of alkaloid from the seeds, but a mixture of ether, alcohol and ammonia gives a complete extraction.

The author had isolated two alkaloids, the second in smaller quantity, and a third alkaloid has been found by Dr. Wiley.

The calycanthus-alkaloid gives different colored reaction from the salts.

The means of a series of combustions by Dr. W. A. Noyes gave the following result:

Carbon	71.56
Nitrogen	15.26
Hydrogen	8.34
Oxygen	4.84
	100.00

Dr. Noyes believes the formula to be $C_{17}H_{23}N_3O$.

Its specific rotary power is exceedingly high, being ten times that of cane sugar.

The sulphate is a white prismatic salt giving yellow oxidation products when heated in a sealed tube with nitric acid.

The author described the various salts which he had prepared, and exhibited the color reactions with both the salts and the alkaloids.

Prof. Breneman's review of the Cleveland meeting had been postponed, owing to the length of programme at the January meeting of the section.

The work of Prof. Maberry on oils, his laboratory and apparatus for conducting the protracted distillations of oils under reduced pressure were briefly described.

Dr. Durand Woodman exhibited a simple lecture table apparatus for experimentally demonstrating the luminosity of the acetylene flame. The meeting was then adjourned until March 6th.

DURAND WOODMAN,
Secretary.

NEW BOOKS.

Primary Factors of Organic Evolution. E. D. COPE. Chicago and London, The Open Court Publishing Co. 1896. Pp. xvi+547. $2.00.

Greenland Icefields and Life in the North Atlantic. G. FREDERICK WRIGHT and WARREN UPHAM. New York, D. Appleton & Co. 1896. Pp. xv+407. $2.00.

Die Insel Tenerife. HANS MEYER. Leipzig, G. Miezel. 1896. Pp. viii+328.

Elements of Botany. J. Y. BERGEN. Boston and London, Ginn & Co. Pp. viii+57.

SCIENCE

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SCIENCE

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CONTENTS:

*REMARKS ON THE PROGRESS OF CELESTIAL MECHANICS SINCE THE MIDDLE OF THE CENTURY.**

THE application of mathematics to the solution of the problems presented by the motion of the heavenly bodies has had a larger degree of success than the same application in the case of the other departments of physics. This is probably due to two causes. The principal objects to be treated in the former case are visible every clear night, consequently the questions connected with them received earlier attention; while, in the latter case, the phenomena to be discussed must ofttimes be produced by artificial means in the laboratory; and the discovery of certain classes of them, as, for instance, the property of magnetism, may justly be attributed to accident. A second cause is undoubtedly to be found in the fact that the application of quantitative reasoning to what is usually denominated as physics generally leads to a more difficult department of mathematics than in the case of the motion of the heavenly bodies. In the latter we have but one independent variable, the time; while in the former generally several are present, which makes the difference of having to integrate ordinary differential equations or those which are partial. Thus it happens that, while the

*Presidential address delivered before the American Mathematical Society, December 27, 1895, by Dr G. W. Hill.

science of astro-mechanics is started by Newton, that of thermal conductivity receives its first treatment, at the hands of Fourier, more than a century later. In addition to these two causes, ever since the discovery of the telescope the application of optical means to the discovery of whatever might be found in the heavens has always had a fascination for mankind. And, as the ability to coördinate and correlate the facts observed much enhances the enjoyment of scientific occupation, it has resulted that many who began as observers ended as mathematical astronomers. Thus our science has had relatively a large number of cultivators.

A thoroughly satisfactory history of our subject is yet to be written. We have only either slight sketches of the whole, or elaborate treatments of special divisions of the science, and none of them coming down to recent times. Among the former may be mentioned Gautier's *Essai historique sur le problème des trois corps*, which appeared in 1817. Also Laplace's historical chapters in the last volume of the *Mécanique Céleste*. Todhunter's History of the theories of attraction and the figure of the earth is an example of the latter class. Such books as Todhunter's—of which Delambre has given an earlier example in his *Histoire de l'Astronomie*—can hardly be regarded as history; they resemble rather extensive tables of contents of the literature examined, accompanied by short comments. However, in many cases, they are more useful to the student than formal histories would be, as, when judiciously compiled, they may, as epitomes in our libraries, take the place of a large mass of scientific literature. The History of Physical Astronomy, by Robert Grant, is a book that comes down to 1850, and professedly covers the whole of our subject. But only one-third of this book is devoted to astro-mechanics, the rest dealing with what is really observational and descriptive astronomy. Moreover, the author indulges so much in diffuse veins of writing, that but a small fraction of the 200 pages is really given to purely historic statement. As far as the lunar theory is concerned, the third volume of M. Tisserand's *Traité de Mécanique Céleste* constitutes a fair history. But it must be borne in mind that the author's plan is to notice only the disquisitions having a first-class importance; hence his history is incomplete in this respect.

In America we are not well situated for investigations of this character, on account of the meagerness of our libraries. Of no inconsiderable number of memoirs and even books, having at least some importance in our subject, there exist no copies in the United States. Hence, should an American be inclined to undertake the task of writing the history of our subject, he must at least perform some of the work abroad.

In the present discourse it is proposed to touch very lightly the more important steps made since the middle of the century, the time at our disposal not admitting fuller treatment.

And first we will take up Delaunay's method, proposed for employment in the lunar theory, but quite readily extended to all classes of problems in dynamics. The first sketch of this method, given of course by the author himself, appeared in the *Comptes Rendus* of the Paris Academy of Sciences, in 1846. It professes to be merely an extract from a memoir offered for publication in the collections of the Academy, which must, however, have been afterwards withdrawn to make place for the two volumes of the *Théorie du Mouvement de la Lune*. When this extract is compared with the earlier chapters of the latter work, it is perceived that Delaunay has, to some extent, modified and improved his method in the interim between 1846 and 1860. In this long period nothing appeared from the author on this subject. He must have been profoundly engaged in applying his method to the motion of the moon. Tisserand's exposition of this method is somewhat more brief than the author's own. But when the necessary modifications are introduced into Delaunay's procedures, to make them applicable to the more general case of the motion of a system of bodies, the establishment of the formulas can be rendered still more brief.

There is one point in reference to Delaunay's method which, as far as I am aware, has escaped notice. This method consists in a series of operations or transformations, in each of which the position of the moon in space is defined by six variables, the number three being doubled in order that the velocities, as well as the coordinates, may be expressed without differentials. The aim of the transformations is to make one-half of these, which Poincaré has called the linear variables, continually approach constancy, while the other half, named the angular variables, continually approach a linear function of the time. But at any stage of the process the position of the moon, as well as its velocity, is definitely fixed by the six variables produced by the last transformation, provided that the proper degree of variability is attributed to them, just as, before any transformation was made, the six elements of elliptic motion, usually denominated osculating, defined them; the point of difference to be noticed being that the more the transformations are multiplied, the more complex becomes the character of the expression of the former quantities in terms of the latter. But, however great may be the number of transformations, the series evolved have always one consistent trait, viz., that the angular variables are involved in them only through cosines or sines of linear functions of these variables, the linear functions being formed with integral coefficients. Now, as in all this work we are obliged to employ infinite series, the question of their convergence is an extremely important one. The inquiry in this respect may be divided into two parts, mainly independent of each other. These are, convergence as respects the angular variables, and convergence as respects the linear variables. The first part is much the more simple. Regarding each of the coefficients of the series we employ as a whole, that is, representing it by a definite integral, it is quite easily perceived that the said series are both legitimate and convergent when, giving the angular variables the utmost range of values, still no two of the bodies can occupy the same point of space. In the contrary case the series are evidently divergent. This condition affords certain limiting conditions for the values of the linear variables. Could we trace these limiting conditions through all the transformations, and obtain by comparison the formulas to which these tend when the number of transformations is made infinite, we should be in possession of the conditions of stability of motion of the system of bodies. The second part of the inquiry relates to the expression of the mentioned coefficients by infinite series proceeding according to powers and products of certain parameters which are functions of the linear variables. It is well known that, in the case of elliptic elements, Laplace and Cauchy almost simultaneously showed that the series are convergent when the eccentricity does not exceed a fraction which is about two-thirds. The determination of the conditions of convergence, after certain transformations have been made in the signification of the elements, is undoubtedly a more complex problem; nevertheless, it seems to be within the competency of analysis as it exists at present.

The discovery of the criterion for the convergence of series proceeding according to powers and products of parameters is due to Cauchy, and is a most remarkable contribution to the science of mathematics. Supposing that the parameters begin from zero values, this criterion amounts to saying that the moment the function, which the series is to represent ceases to be holomorphic, or becomes infinite, that moment the series ceases to be convergent. Consequently, if a space, having as many dimensions as there are parameters in the case, be conceived, and a surface be constructed in it formed by the consensus of all the points where the considered function ceases to be holomorphic, then, provided the values of the parameters define a point within this surface, that is, on the same side where lies the origin, the series will be convergent. Generally this surface will be closed, and, within it, the function will not take infinity as its value.

Without any mathematical reasoning the propriety of the principle just enunciated may be perceived. Since it is possible for the series in powers and products to give only one value for the function, the moment the latter may have any one of several values, the series fails to give them all; and, as there is no reason why any particular value should be selected, the conclusion must be that it does not represent any of them. Also, it is easy to see that, when the function takes infinity as its value, the series fails to represent it.

In applying this principle to the series involved in the treatment of the problem of many bodies by Delaunay's method, it appears, at first sight, as if we must have some finite representation of the coefficients in question in order to discover the particular points at which they cease to be holomorphic, such, for instance, as is given by an algebraic or transcendental equation. But this is not imperative, as it is often possible to make this discovery from certain recognized properties of the function considered, without being in possession of its form explicitly or implicitly. It appears probable that, in the class of cases considered, the mentioned coefficients can be represented by multiple definite integrals, all taken between the limits 0 and π, the independent variables being those which have been denominated angular. Such functions are always holomorphic, provided that the expressions under the signs of integration are themselves holomorphic between the mentioned limits. If the statement just made be admitted, although it may be impossible to write explicitly the mentioned expressions, we may, nevertheless, be certain that they remain holomorphic, provided that the linear variables, which may be the same as the parameters considered, are so restricted in their range of values that no matter what values the angular variables receive, no distance between any two bodies of the system can vanish. Or, in other words, that the R of Delaunay must never become infinite. Thus it seems probable that the conditions of convergence for Delaunay's series are precisely identical with those for the stability of motion of the system.

The series arising in Delaunay's method, as applied to the moon, contain five parameters; the number would be six were the moon's mass not neglected. We should also have six in the application of the method to two planets moving about the sun; however, should we employ the well-known function $b_s^{(i)}$ of Laplace, the number would be reduced to five. It ought to be possible, therefore, after the performance of a limited number of operations, to assign limiting values to these parameters, below which the series would certainly be convergent. This also involves the possibility of finding limits to the errors committed by truncating the series at a certain order of terms. Again, provided the time is limited to a certain interval, the capacity of these truncated series for representing the coördinates of the planets could be shown by giving superior limits to the errors necessarily involved.

One more remark may be made before we leave Delaunay's method. In every operation or transformation half the integrals are obtained without the intervention of the time, and from these solely are obtained the ranges of values for all the linear variables. As no integrating divisors appear in their expressions, it follows that the question of stability is not affected in any way by the vanishing of these. Moreover, the presence of a libration in the angle of operation does not necessitate any change in the procedure. The integrating divisors which appear in the expressions for the angular variables, obtained through quadratures, may cause difficulty, but this can generally be removed by a modification of the parameters employed in the development of the coefficients in series. Beyond this it does not seem necessary to attend particularly to the terms which Professor Gyldén has designated as critical.

To give a succinct idea of the scope of this method, it may be said that it is applicable whenever, in the system, the planets maintain their order of succession from the sun. In systems where that undergoes change, as is the case with the group of minor planets, supposing their action on each other is sensible, it is not applicable.

Delaunay's method has not yet received all the developments and applications it is susceptible of.

The treatise of Hansen on the shortest and most ready method of deriving the perturbations of the small planets was published in the interval 1857–1861. But as the principles on which it is founded had been elaborated and communicated to the public some years earlier, it is, perhaps, more properly to be assigned to the first half of the century. In consequence, I pass it over with this slight mention.

Perhaps the most conspicuous labors in our subject, during the period of time we consider, are those of Professor Gyldén and M. Poincaré. We will limit our attention, for the remainder of this discourse, to the consideration of these investigations.

Professor Gyldén began work with the methods of Hansen and was gradually led to modifications of them looking towards their use for indefinite lengths of time. This quality has latterly become imperative with him, and he has recently published the first volume of what is evidently intended to be a lengthy work entitled *Traité Analytique des Orbites Absolues des Huit Planètes Principales*. To show the drift of Professor Gyldén's investigations, we cannot do better than give an analysis of this volume. At the outset the author introduces a class of curves he names periphlegmatic, that is, curves which surround a flame. The definition of this sort of curve is that it describes continually the space between two concentric spheres, and, at every point, turns its concavity towards the intersection of the radius vector with the inner sphere. In an application to the solar system, the sun is supposed to occupy the common center of the spheres. The investigation is at first limited to the case where this curve is plane. A differential equation of the second order is derived which the radius vector of this curve satisfies, the independent variable being the angle described. The perpendicular distance between the spheres is called the diastem. The spheres are supposed to be drawn so that they touch the curve at the points where the radius becomes a maximum or minimum. Thus, in some cases, the spheres are regarded as fixed, in others as movable. In the latter case, however, the sum of their radii is supposed to remain constant. Thence we have two groups of periphlegmatic curves ; those with constant and those with variable diastems. The author gives examples of both these groups, in most cases of which the line of apsides is variable, and considers the situation and density of the points of intersection of these curves with themselves.

The idea of an absolute orbit of a planetary body is this: an oval symmetrical with regard to an axis movable in space. While the axis remains constant in length (the half of it is called the protrometre), the velocity of its motion may vary, and the diastem may also vary. Prof. Gyldén, however, admits into the expressions of these variations only terms whose period would become infinite did the planetary masses vanish. These terms he calls elementary. But elementary terms in the diastem and the longitude of the perihelion can produce terms in the coördinates having periods which differ but little from the time of revolution of the planet. These are also called elementary terms. But the two classes are distinguished, the first as being of the type (A), and the second as of the type (B). In all the formulas relative to this matter the author insists on keeping the arc described by the radius as the independent variable.

The coördinates are only approximately given by the preceding apparatus of expressions. They must then have certain complements added to them; these, however, are all composed of terms which would vanish with the planetary masses.

In deriving the elementary terms in the radius of a planet through the integration of a linear differential equation of the second order, Prof. Gyldén attaches much price to his method of establishing the convergence of the series formed by the successive terms. As the latter are obtained through division by divisors of the order of the planetary masses, it might be feared that some of them would turn out to be very large. But the author prevents this by retaining in the coefficient of the dependent variable in the differential equation a quantity equivalent to the sum of the squares of all the coefficients in the integral. This is named the horistic or limiting function. It is plain such an expression could be introduced in the mentioned coefficient, provided that the linear equation is the truncated form of an equation containing the cube of the variable. And in the problem of planetary motion the approximations may always be so ordered that this shall be the case.

With regard to the coördinate which exhibits the departure of the planet from a fixed plane, Prof. Gyldén does not greatly deviate from the procedure of Hansen in following the displacement of the instantaneous plane of the orbit. Only here, as in the preceding treatment of the radius, he would sharply distinguish the elementary and non-elementary terms.

At this point is introduced certain new nomenclature. As before we had diastem, now we have anastem to denote the product of the radius and the sine of the inclination; and what has generally been called the true argument of the latitude is here called the anastematic argument. Any angular magnitudes which are constantly moving through the circumference are astronomic arguments; and when they have the same mean velocity of rotation they are isokinetic; and isokinetic arguments are homorhythmic when, in each revolution through the circumference, they always retake together the same corresponding points. In like manner, the true anomaly is the diastematic argument, and we have diastematic and anastematic coefficients and moduli. It will be seen from this that Prof. Gyldén does not shrink from imposing on us the labor of learning new terms.

Thus far we have been engaged in deriving the equations of the path followed by a heavenly body; it remains to show how we may find the point on that path occupied by the body at a given moment. There is then necessary an equation between the time and the variable assumed as independent, that is, the orbit longitude, or, more properly, the amount of angle described by the radius vector. If we suppose the absolute orbit to be described by the planet so that equal areas are passed over by the radius in equal times, it is plain that, on the attainment of a given longitude, a definite amount of time must have elapsed since the epoch. This is what Prof. Gyldén calls the *reduced* time; and he computes the difference between it and the actual time required by the theory of gravity for the planet to arrive at the stated direction. This mode of proceeding does not differ from Hansen's, except in the point that the absolute orbit is substituted for a fixed ellipse.

But this gives us correctly only the orbit longitude; for the radius and the latitude, which correspond in the absolute orbit to this reduced time, are not quite those which the planet has at the actual time. Consequently, Prof. Gyldén proposes to compute two corrections, the one to be applied to the product of the eccentricity into the cosine of the true anomaly, the other to the sine of the latitude. Also the reduction of the orbit longitude to the plane of reference must be manipulated so that it comes out correctly.

The employment of the orbit longitude as independent variable throughout all the integrations necessitates a mass of very intricate transformations of terms from one shape into another. Also the integrations which bear on elementary terms must be kept distinct from those which bear on non-elementary terms. A degree of complexity is thus imparted to the subject which makes it difficult to see when one has really gathered up all the warp and woof of it. Prof. Gyldén has nowhere removed the scaffolding from the front of his building and allowed us to see what architectural beauty it may possess; it is necessary to compare a large number of equations scattered through the volume before one can opine how the author means to proceed.

The advantages claimed for the method are that it prevents the time from appearing outside the trigonometrical functions, and that it escapes all criticism on the score of convergence. The first is readily conceded, but many simpler methods possessing this advantage are already elaborated, and it is not so clear that the second ought to be granted.

No completely worked out example of the application of this method has yet been published. The great labor involved will naturally deter investigators from employing it.

In 1890 was published the memoir of M. H. Poincaré entitled *Sur le problème des trois corps et les équations de la dynamique*, and which obtained the prize of the King of Sweden. Most of the results of this memoir were worked over and presented anew with greater elaboration and clearness by their author in *Les Méthodes Nouvelles de la Mécanique Céleste*. Here we find a large number of new and very interesting theorems.

First is to be noted the class of particular solutions in the problem of the motion of a system of material points which are now named *periodic solutions*. The initial relative positions and velocities of the several points are so adjusted that, after the lapse of a definite time, the latter retake them. Hence is evident a method which may be employed to elaborate this special case of motion, viz., by the tentative process with mechanical quadratures. M. Poincaré has divided this sort of solutions into three classes, of which, however, the second and third are not essentially different. He has shown that, in the latter classes, the values of the arbitrary constants of the problem must be so adjusted that no secular inequalities, or, as Professor Gyldén calls them, elementary terms, may arise. The number and variety of these particular solutions is far greater than one would at first sight imagine.

We come now to a second class of particular solutions named by the author *asymptotic*. It arises from the consideration of solutions differing very little from periodic solutions. Here we have to deal with linear differential equations having periodic coefficients. The integrals of these contain in their terms exponential factors, and on the nature of the exponents of these factors depends the quality of the resulting solutions. M. Poincaré has named these exponents *characteristic*. They are roots of an algebraic equation of a degree equal to the number of dependent variables involved in the question. If any of these roots are imaginary with real portions or wholly real, we are in presence of asymptotic solutions. The algebraic equation mentioned contains the unknown only in even powers; hence the characteristic exponents are in pairs having the same absolute value, but with contrary signs. In all the cases presented by astronomy, where, on account of the near approach to circular motion, a periodic solution can be taken as a first approximation, it appears that the squares of the characteristic exponents are all real and negative. Thus, there is no call here to consider this sort of solution, and this fact must much diminish the interest of the astronomer in it. M. Poincaré has, however, elaborated it with great pains, showing how the effect of higher powers of the deviations from the periodic solution may be taken into account. The series resulting are, nevertheless, divergent, as in other cases.

The second volume of the *Méthodes Nouvelles* is devoted to the elaboration and consideration of various processes for developing the integrals of planetary motion according to the powers of a small parameter. The chief of these are due to Professor Newcomb and MM. Lindstedt and Bohlin; but M. Poincaré has augmented the number of them by introducing modifications of his own. All involve the principle of recurrence; that is, the first step is the only one which is independent, the following depend on all that precede. These methods, in their general aspect, do not differ from the old developments in powers of the disturbing force, except the operations are so adjusted that the time never escapes from the trigonometric functions. This is accomplished by greatly augmenting the number of the elementary arguments, and by supposing that the rate of motion of each of these is developable according to integral powers of the beforementioned parameter, or, in some cases, of its square root.

When there is more than one elementary argument, the series obtained in all these ways are pronounced to be generally divergent in the rigorous sense of the word. M. Poincaré brings forward several methods of proof of this. The first depends on the presence of small divisors in the expressions of the coefficients. However, when we do not insist on developments in powers of a parameter, this method of proof has no application. Another method is derived from the principle that two characteristic exponents vanish for every uniform integral that exists. But the integrals which necessitate this conclusion must not only be uniform, they must be valid for every possible case of the problem. Now the integrals known as those of the conservation of living forces and of areas are of this nature; but the integrals derivable from the series of Delaunay, Newcomb and Lindstedt are valid only for a limited range in the values of the linear variables. For instance, in the problem of the three bodies, if the deformation of the triangle formed by these bodies is such that we cannot find any two sides, one of which sustains to the other an invariable relation of greater to less, we cannot apply the mentioned series. And here it is well to note that the defect of convergence does not arise from the application of the processes of integration, but already exists in the development of the perturbative function before integration commences. Thus Delaunay's development of this function at the beginning of his lunar theory is divergent and illusory, unless we have the lunar radius in apogee always less than the solar radius in perigee, and that without regard to the mode of expressing the coefficients. Some of the particular integrals relied upon by M. Poincaré to establish the vanishing of all the characteristic exponents, in case we accept M. Lindstedt's series as valid, lie, so to speak, on the boundary of the domain in which these series are convergent.

In the third place an appeal is made to the alleged non-existence of analytic and uniform integrals beyond those already known. Were this non-existence clearly established it would decide the question on the side where M. Poincaré has placed himself. But, at least as far as the non-existence of integrals of this nature in a limited domain for the linear variables is concerned, the proof given for it is quite defective. This proof consists in ascertaining how these integrals, supposing them to exist, would behave should we attempt to derive periodic solutions from them. It is difficult to present this matter without the assistance of algebraic formulas; nevertheless, it may be attempted. Let there be a number of equations whose left members are formed by the product of two factors. When we pass to a periodic solution, one of these factors becomes zero. What conclusion can we draw from each of the thus modified equations? Evidently one of two things: either the remaining factor of the left member is infinite and the right member indeterminate, or it is finite and the right member a vanishing quantity. Now in case we are obliged to accept the first conclusion, were it only but once, M. Poincaré has demonstrated the non-existence of integrals; but, granting that it is proper in every case to accept the latter conclusion, the demonstration fails. Now he declines to consider the latter alternative, saying that he does not believe that any problem of dynamics, presenting itself naturally, occurs where the right members of the mentioned equations would all vanish. But it should be borne in mind that, while they do not vanish in the general equations, the adjustment of the values of the linear parameters required by the passage to a periodic solution may bring about their vanishing. Thus, in the lunar theory, a periodic solution is brought about by making $e=0$, $\acute{e}=0$, and $\gamma=0$, the result is the vanishing of every coefficient having any of these quantities as a factor.

M. Poincaré appeals in another place to the fact that the Linstedt series, if convergent, would establish the non-existence of asymptotic solutions. But this observation is irrelevant for the reason that the domains of the two things are quite distinct. In any case where Lindstedt's series are applicable there are no asymptotic solutions, and where there are asymptotic solutions Lindstedt's series would be illusory.

We owe much to M. Poincaré for having commenced the attack on this class of questions. But the mist which overhung them is not altogether dispelled; there is room for further investigation.

G. W. HILL.

ADMISSION OF AMERICAN STUDENTS TO THE FRENCH UNIVERSITIES.

THE Conseil Supérieur de 'l' Instruction Publique has issued a decree removing the restrictions upon the admission of American and other foreign students to the French universities and giving them a status substantially similar to that accorded by the German universities. This important concession by the French authorities is the direct result of a vigorous movement instituted by Prof. H. J. Furber, of the University of Chicago, who in the latter part of May, 1895, addressed to the Ministry of Public Instruction a memorial, calling attention to the appreciable increase in the number of Americans engaged in post-graduate work in Europe and the vastly greater percentage of foreign students at the German universities as compared with those of France. The memorial recited that at the Sorbonne there are but 30 Americans enrolled, while some 200 are at present in attendance at the University of Berlin, and in the smaller institutions of France and Germany the disparity is even greater.

Unless it be assumed, argues Mr. Furber, that France is intellectually inferior to Germany, the indisposition on the part of American students to avail themselves of the advantages offered by the French schools would appear to indicate either a failure to appreciate the unequalled excellence of the latter in many directions, or else some obstacle preventing the enjoyment of the opportunities which they afford. It is difficult to conceive, however, that our countrymen are without knowledge of the refinement of culture for which the French schools are so justly famous, and the inference seems conclusive that the scarcity of American students in France is attributable to the difficulties which beset the foreigner in gaining admission to their courses.

In Germany an American is allowed to matriculate and qualify for a degree upon the presentation of a bachelor's degree from some reputable institution of learning in the United States, and throughout his course is at liberty to elect the studies he may desire to pursue. He is free from examination, except when he chooses to apply for a degree, preparatory to which it is incumbent upon him to submit a satisfactory thesis upon some subject of original research in which he has been personally engaged. In fact, the only formalities required of the candidate for academic honors are the furnishing of credentials certifying to the proficiency of his early schooling, a certain minimum time spent at the universities of Germany, and a severe test of his abilities at the termination of his course.

In France, on the contrary, the student is subject to many rigorous restrictions which practically exclude the greater number of Americans. The bachelor's degree is not accepted as sufficient for entrance to many of the faculties, and the student is limited to an arbitrarily prescribed course of study and subjected to severe tests of progress at frequent intervals, depriving him in no small degree of his freedom of research and original investigation. Students from the United States are, with rare exceptions, men who have passed beyond the rudimentary grades of education and attained the rank of specialists. They are of intellectual maturity graduates of our universities and colleges, and are in quest not of discipline but of knowledge. They do not desire that any essential requirement in the French regulations be suspended, or that the grade of scholarship necessary either to matriculation or to graduation be lowered in their favor. They do insist, however, that the peculiarity of their purpose and position be duly considered, and that they be permitted to fulfill through some equivalent the requirements which, owing to the very nature of their case, are otherwise virtually prohibitive. The American student is not averse to the requirement of a somewhat lengthy term of residence in France, but he does maintain that he shall have the privilege of utilizing the period of study as he shall deem most profitable and most nearly in accordance with the plan which he has mapped out for himself.

On the 7th of June, Mons. M. Bréal, the eminent French educator and member of the Institute of France, published in the

Journal des Debats a resumé of Mr. Furber's memorial, which at once enlisted the sympathy of eminent French scholars, and resulted in a conference at the Sorbonne on the 26th of June, at which the Comité Franco-Américain was organized for the purpose of advocating before the proper authorities the desired changes in the French regulations. In July a committee styled the 'Paris-American University Committee' was also formed from among the Americans resident in Paris to coöperate with the Comité Franco-Américain, and at the invitation of Dr. Thomas W. Evans, Chairman of the Committee, a number of American and French gentlemen interested in education assembled at his residence in Paris for the purpose of deliberating upon the most practicable course to be pursued to bring about the desired reforms. Addresses were made by Mons. Bréal, Chairman of the Comité Franco-Américain, Prof. Furber and others, and the various difficulties relative to matriculation and graduation in the French universities were thoroughly discussed.

Shortly after the formation of the Paris-American Committee, Prof. Simon Newcomb, at the solicitation of Prof. Furber, organized in Washington an American committee to coöperate with the Comité Franco-Américain and to give authoritative expression of the sympathy of the people of the United States in the movement. The Committee numbers among its members Prof. Newcomb, Chairman; Dr. S. P. Langley, Secretary of the Smithsonian Institution; President Charles W. Eliot, of Harvard University; Hon. Andrew D. White; President Timothy Dwight, of Yale University; President D. C. Gilman, of Johns Hopkins University; Hon. W. T. Harris, U. S. Commissioner of Education; President Seth Low, of Columbia College; Hon. Carroll D. Wright, U. S. Commissioner of Labor; President J. B. Angell, of the University of Michigan; President J. C. Schurman, of Cornell University; Prof. E. R. L. Gould, Secretary of the International Statistical Association; President B. L. Whitman, of Columbian University; President G. Stanley Hall, of Clark University; and G. Brown Goode, Assistant Secretary of the Smithsonian Institution, who acted as Secretary. A meeting of the Committee was held at the Columbian University on November 13th at which resolutions were adopted expressing the sense of the committee that America would heartily welcome the proposed changes in the French regulations, and suggesting, as a means of inducing American students to avail themselves of the precious advantages offered by the well-organized system of university instruction of France, that the French authorities accept the bachelor's degree as the equivalent of that of the French Lycée, and that owing to the lack of familiarity with the French language, the frequent rigorous examinations required by the French system be dispensed with in the case of foreign students. The committee strongly opposed the suggestion of establishing a degree for Americans only, which should have less significance than that conferred upon native students. These suggestions were elaborated by the French committee, presented to the Ministry of Public Instruction, and defended by the committee before the Conseil Superieur. After due deliberation, the latter body, on the 17th of January, voted a decree introducing into the French faculties of science all the best features of the German system. In accordance with the decree, a student will hereafter be admitted to these faculties on an American bachelor's degree, and will be permitted to choose his studies. After pursuing any scientific course for a year, he can, if he wishes, apply for an examination in this branch and, if successful, obtain a *certificat d'ètude*. Three such certificates will entitle him to a *licence-ès-science*, and upon the presentation of a satisfactory thesis he will be eligible to the French doctorate. If he has the ability, he can, at his pleasure, discharge all three subjects in one year; or he can do so in successive years, migrating, if he wishes, from one university to another, and studying at the same time whatever other subject he may choose.

The French system as modified possesses one distinct advantage over that of Germany. In the latter country the student must present his thesis before he is admitted to examination for the doctor's degree, and if he fails to present a satisfactory dissertation he is without a degree or diploma. In France, however, the examination precedes the presentation of the thesis, and the student receives independent credits for every portion of his work. If he acquits himself in one branch only, he has his certificate, three of which, as has been explained, give him the *licence-ès-science.* If interrupted in his work before securing a degree he may withdraw with honorable credentials for at least that portion of his work which has been accomplished.

The degree rendered by the Conseil has reference only to the faculties of science. It is hoped, however, that a similar arrangement may be had in the Department of Letters. Important concessions have already been made in connection with the admission of American students to the faculties of medicine, and Mons. Bréal, in a letter to Prof. Furber, writes that the Faculty of Protestant Theology manifests a most liberal disposition in this regard. The changes which the French have made are of very great value. It now rests with the students of America to manifest their appreciation and to avail themselves of the facilities which are placed within their reach, in the same warm spirit in which they are offered. G. Brown Goode,

Secretary of the American Committee.

APPLICATION OF THE X-RAYS TO SURGERY.

The manifold uses to which Röntgen's discovery may be applied in medicine are so obvious that it is even now questionable whether a surgeon would be morally justified in performing a certain class of operation without having first seen pictured by these rays the field of his work, a map, as it were, of the unknown country he is to explore. It may be well to consider first what has already been accomplished in this direction, and then briefly to enumerate a few achievements we may expect when the time of exposure is lessened, the intensity of this form of radiation increased and, possibly, the rays brought to a focus.

Mosetig, of Vienna, was the first to make a practical application of the new discovery in surgery. The case was one of double phalanges at the tip of the big toe. It was impossible, by the usual means of diagnosis, to decide which of these bones communicated directly with the middle phalanx, thus forming the joint, and which was the supernumerary bone. It was, therefore, deemed advisable to amputate at the distal articulation, but a picture secured by the Röntgen process revealed very clearly that one of the phalanges formed a portion of the true joint, the other being merely connected therewith by means of an osseous union. It was then a very simple matter to remove the extra phalanx, the surgeon having before him a complete picture of the osseous parts involved. The satisfaction of the patient may also be imagined, for he could see for himself the advisability and simplicity of the operation. The next case of Mosetig was one in which a bullet had lodged in the fifth carpal bone and there become encysted. Various means had been previously tried, but unsuccessfully, to locate the bullet. In the picture in this case may also be noticed a sessimoid bone; and here attention should be called to the fact that these extra bones should not be mistaken for foreign bodies. Neusser's experiments were made upon objects outside of the body, and of these the first telegraphic newspaper reports were most confusing, many persons being lead to believe that a calculus had been photographed within a kidney in the living subject. Prof. Neusser was able to obtain a distinct picture of a phosphatic vesical calculus through four centimeters of calf's liver. Haschek and Lindenthal have shown the fibrous bands uniting old injured bones. Having injected the arteries in the hand of a cadaver, they have shown a method of making a plate which will be useful for anatomical instruction. Lannelongue, of Paris, has diagnosed by this process tuberculous arthritis. Cox, of Montreal, early in his investigations, secured the picture of a bullet in the calf of the leg; the bullet, which was afterward removed, being located between the tibia and fibula. Buckshot has been found by Pupin; needles and glass have been pictured by several observers and afterward removed. Robb, of Trinity, diagnosed a luxation and fracture in the hand of a patient who was under treatment for another condition. Röntgen has recently prepared a picture of a fracture of the forearm with much displacement. Lodge has a picture showing a bullet in the wrist. Of the tissues of a cat, Reid finds bone the most, and cartilage the least, opaque. It is reported by the *Lancet* that a thigh bone attacked with osteomyelitis has been pictured. A skiagraph of a suppressed and a rudimentary phalanx is shown in the *Boston Medical and Surgical Journal* of February 20, 1896. The writer has been able to discover in a living subject a doubling of one of the carpal bones and those of the corresponding first row of phalanges, in a case of polydactylism, with webbed fingers. The same picture also showed osseous union at the tips. In another case ankylosis of the terminal and middle phalanges of a finger is seen. And so the list might be increased by observations made throughout the civilized world, as wherever these experiments have been repeated physicians have naturally seized upon the opportunity to benefit the patient.

Carbutt, of Philadelphia, suggests that celloidin films may be moulded to the contour of the body, thus facilitating the taking of a picture of the thicker portions of the arm, the leg, or the trunk. He is also preparing plates which will be peculiarly suitable to the action of this form of energy.

In conclusion, let me cite a few of the many instances in which this discovery may be useful in medicine and surgery. First. In the diagnosis of luxations and fractures, at times a difficult or impossible procedure, it will be possible, in certain cases, to picture a fractured bone, reduce and dress it, and afterward secure a skiagraph through the bandages, thereby demonstrating beyond doubt whether there has been proper approximation of the ends of the bones. Again, it may be practicable to fix the time at which union has taken place, and to determine accurately the amount of osseous deposit that has occurred on the bone, it being a well known fact in surgery that this union takes place in a longer or shorter time, depending upon age and individual peculiarities. The distortion of bones when pictured upon different planes might doubtless be overcome by the use of mirrors, or other apparatus.

Second. Certain foreign bodies, as glass, bullets and needles, may be diagnosed not only in the extremities, but in other parts of the body. A jackstone lodged in the larynx, or a set of teeth, penknife, coin, intubation tube, etc., in the intestinal tract might be revealed by a careful study of the plate. Renal and urinary calculi may possibly be located under favorable conditions.

Third. It may be possible to distinguish in certain cases an adulterated from unadulterated drug, *e. g.*, some tinctures permit the rays to pass much more readily than others. Flaws in instruments, especially those made of aluminum, might be detected by these rays. Experiment alone will decide whether bacteria will be influenced by the rays in the same manner as certain colonies of organisms are injured by exposure to the direct action of the sun. Park, of New York, has exposed a culture of the diphtheria bacillus for thirty minutes to the rays from a Crookes tube without any result being noted. He who is able to secure a picture of the brain will accomplish more than can be expected from the present state of our knowledge of the X-rays.

The suggestion has been made that in our large cities skiagraphic institutions should be erected and equipped, to which physicians or surgeons could send patients, and where, under their direction, pictures of the desired portion of the body could be prepared, just as a physician now writes a prescription which is sent to the druggist to be compounded. Our large hospitals where numerous accident cases are brought should have in the near future a plant sufficient to prepare skiagraphic reproductions at short notice.

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CURRENT PROBLEMS IN PLANT MORPHOLOGY.

ON SOME CHARACTERS OF FLORAL GALLS.

THE growing interest in ecology which is so marked a feature of botanical investigation during the last five years has occasioned new and valuable work on galls, so that now for the first time compendious works have begun to appear, in which a really scientific and adequate account of these curious structures is attainable. An excellent resumé in popular style is that given in Kerner and Oliver's *Natural History of Plants*, Vol. II., pp. 518–554. That upward of 1,600 different kinds of galls have been described is noted, and an attempt is made to classify them. With characteristic looseness Kerner divides galls into fungus galls and insect galls, but this is quite inadequate, for algæ, among plants, also produce galls, *e. g.*, Phytophysa treubii W. v. B.,* which attacks the leaves of Pilea at Buitenzorg. And "insects," under which Kerner includes Arachnoidea, are not at all the only gall-producing animals, for nematodes (afterwards mentioned by Kerner) and rotifera are well known as efficient causes in cediciogenesis.

Kerner's classification of galls from a plant anatomical point of view is, however, excellent and is reproduced with some slight modifications in Ludwig's *Lehrbuch der Biologie der Pflanzen.*† Fundamentally galls are either simple or compound, as one or several organs take part in their production. Each class is divided into a number of subclasses, but the details need not be gone into here. The account given by Ludwig is compact and clear.

The changes produced in flowers and inflorescences when they are subjected to stimulus from a cecidiogenic organism may be classified as: 1. Chlorosis. 2. Multiplication of parts. 3. Metamorphosis of parts. 4. Suppression of parts. 5. Hypertrophy, general or restricted. 6. Antholysis. 7. Fusion of parts. 8. Fasciation. Examples of these are as follows: 1. Green flowers of Veronica. 2. Double flowers of Rhododendron. 3. Flowers of Valerianella in which petals are substituted for stamens. 4. Flowers of Anemone nemorosa inhibited by *Puccinia fusca.* 5. Flowers of Lychnis in which a parasitic Ustilago stimulates the growth of the vestigial stamens of pistillate flowers until they rival in structure the normal stamens of staminate flowers. 6. Flowers of gentians in which the carpels

* Weber: Zoolog. Erg. Reis. Niederl. Ost-Ind. Hft. I. 48–71. Leiden, 1890.

† Ludwig: l. c., pp. 98–110. 1895.

are separated under the stimulus of the wound. 7 and 8. Inflorescences showing both fusion and fasciation as when the Ash is attacked by Phytoptus.

The list of papers upon galls is a long one, including such names as De Lacaze-Duthiers, Prillieux, Courchet, Wakker, Fenzling, Frank, Massalongo, Sorauer, Frauenfeld, Loew, Kieffer, Rubsaamen, Schlechtendahl, Delpino, Thomas, Nalepa, Giard, Julin, Van Tubeuf, Magnus, Schroeter, Peyritsch and many others. A recent writer, Molliard,* has brought together in a systematic way the important facts concerning anthocecidia, and has in several instances added materially to our knowledge of the intimate changes effected in flowers by gall producers. The following is a brief resumé of his paper.

Molliard classifies anthocecidia as follows:

I. Phytocecidia: Galls produced by plants.
  1. Peronospora galls: Produced by mildews.
  2. Uredineous galls: Produced by rusts.
  3. Ustilagineous galls: Produced by smuts.
II. Zoöcecidia: Galls produced by animals.
  1. Hemiptera galls: Produced by Aphides.
  2. Diptera galls: Produced by flies.
  3. Phytoptus galls: Produced by mites.

The galls produced in flowers of Dipsacus pilosus by Peronospora violacea show that (1) the pollen-sacs have been atrophied and the pollen mother-cells converted into parenchyma; (2) the embryo sac has been atrophied; (3) the sepals have been hypertrophied.

Knautia arvensis, attacked by the same mildew, shows (1) atrophy of the stamens, due to indirect influence, however, for the mycelium does not penetrate them; (2) atrophy of the ovules, also indirectly produced; (3) metamorphosis and hypertrophy of the corolla; (4) incomplete metamorphosis of the stamens into petals.

Matricaria inodora attacked by Peronospora radii shows (1) coalescences (fusions) of pedicels and flower tubes; (2) torsion of the flower pedicels resulting from a secondary tissue which reacts against the mycelium; (3) atrophy of the sexual organs; (4) metamorphosis of ligulate into tubular flowers and antholysis of the pistil.

*Ann. Sci. Nat. Bot. VIII., 1: 67–245. 1895.

Molliard defines three types of Peronospora cecidiogenic effects:

1. The flower is not modified. Example, P. calotheca De By on Sherardia.

2. The flower is suppressed. Example, P. arborescens on Papaver.

3. The flower is metamorphosed and its essential functions inhibited. Example, P. radii on Matricaria.

The action of various species of Cystopus is summarized to show the quite different effects produced by this genus when compared with the closely related Peronospora. It appears that:

1. There are notable changes in the form, dimensions and contents of the individual cells of the floral organs.

2. New types of cell arrangement are produced.

3. The myrosin (in mustards) is translocalized.

4. The pollen-spore mother cells are converted into vegetative cells.

The action of Uromyces scutellatus on the flowers of Euphorbia cyparissias recalls the well-known case of Lychnis attacked by Ustilago antherarum,* which is discussed anew by Molliard. In Euphorbia cyparissias the effect of the rust is (1) to transform the staminate flowers into pistillate or monoclinous and the monoclinous flowers into pistillate; (2) to cause atrophy of the pollen and embryo sac spores; (3) to cause hypertrophy of the parenchyma in all organs.

The most notable result of smut attacks upon flowers is the so-called parasitic cas-

* Giard and Mangin. Notes sur la castration parasitaire du Lychnis dioica, L.—Bull. Sc. Nat. de Fr. et Belg. II. 150; also Vuillemin: Sur les effets du parasitism de l'ustilago antherarum, Comptes Rend. Hebd. CXIII. 662, 1891, and review of this paper in Botan. Gazette. 17: 17. 1891.

tration, of Giard. This is known in Lychnsi dioica, Saponaria officinalis, Dianthus sinensis, Knautia arvensis and Scabiosa succisa. Parasitic castration arises from the substitution of sterile cells or fungal spores for the ordinarily present pollen-mother cells of the stamens. It is distinguished as *indirect parasitic castration*, by Giard, from the case of Claviceps growing as a substitutionary form and quite destroying the ovary of the rye, where the pseudomorph is said to produce direct parasitic castration.

Flowers attacked by aphides show the following characters:

1. Complete chlorosis in which all the organs of the flower assume the external and internal characters of foliage leaves (Phyllody), example, Sinapis and Torilis.

2. Complete chlorosis with hypertrophy, but the resultant structures differing from foliage leaves (Aphyllody), example, Cerastium, Silene, Valerianella.

The most marked characteristic of flowers converted into cecidia by gall flies is a negative one, viz: the generally slight structural change that they undergo. Hypertrophy is the principal reaction—seen well in flowers of Raphanus, Sisymbrium, Lotus and Daucus. The flowers of Veronica and Cerastium are, however, not particularly enlarged, but become concealed in a mass of cecidial leaves. The fly-cecidia of Lychnis and Scabiosa are distinguished by the formations of numerous hairs, while those of Tanacetum and Spiræa are remarkable for the general substitution of sclerenchyma for parenchyma and might be classed as *sclerotocecidia*.

Phytoptus galls are chiefly remarkable for the cytic changes which take place in them. Epidermal and hypodermal cells partake in the modification. The cytoplasm becomes highly granular, the nucleus acquires large dimensions and is highly chromatophilic. The formation of epidermal hairs is abundant and numerous modifications of the cell contents (chlorophyll, calcium oxylate, etc.) are noteworthy. Doubling, chlorosis, antholysis, atrophy and hypertrophy characterize special cases. On the whole, the Phytoptus galls in floral regions are comparable best with the Aphis galls, though differing in the greater stimulation of epidermal tracts, and the conspicuous formation of hairs which, in Stachys betonica, are even produced in the embryo-sac.

Molliard's general conclusions may be readily condensed into a tabular form, as follows:

I. Modifications undergone by accessory parts of the flower.
- A. Modifications of organs.
  - 1. Accessory parts wither.
  - 2. Accessory parts undergo metamorphosis without hypertrophy.
    - a. Phyllodic metamorphosis.
    - b. Aphyllodic metamorphosis.
  - 3. Accessory parts hypertrophy.
    - a. Total hypertrophy.
    - b. Partial hypertrophy.
- B. Modifications of tissues.
  - 1. Simple modifications, *e. g.*, change in size of parenchyma cells.
  - 2. Modification of cell arrangement.
  - 3. Disappearance of tissues.
  - 4. Appearance of new tissues.
  - 5. Translocalization of characteristic cell contents.

II. Modifications undergone by essential organs of the flower.
- 1. No modification, *e. g.* Sherardia.
- 2. Inhibition of flowers.
- 3. Development of essential organs, but flower fails to open.
- 4. Modification of sporangial areas, so that sterile cells are substituted for spores. (Parasitic castration).
  - a. Castration of pollen sacs.
    - 1. Direct castration. Pollen cells digested.
    - 2. Indirect castration. Pollen cells metamorphosed.
  - b. Castration of ovules.
    - 1. Direct castration. Ovules digested.
    - 2. Indirect castration, where either the embryo sac fails to develop or the egg nucleus of the embryo sac fails to appear (inhibition of germination).

Molliard did not, however, discover a conversion of embryo sac into parenchyma tissue coördinate with the phenomenon so common in stamens.

The synoptical resumé given above, upon examination, indicates that in general the influence of the cecidiogenic stimulus is essentially atavistic in character and results. Chlorosis, antholysis, hypertrophy, all may be considered as reversion phenomena. A peculiarly good example is the conversion in cecidia of ligulate flowers into tubular. The specialized organ becomes more generalized. It is not improbable that cecidia forms, when thoroughly understood, will be found to present a series comparable with the paleontologic or ontogenetic series of organisms, and that they will afford similar ground for speculations concerning descent, if not of species, at least of certain tissues and organs.

CONWAY MACMILLAN.

CURRENT NOTES ON ANTHROPOLOGY.

THE WALL PAINTINGS OF MITLA.

ARCHÆOLOGISTS are well aware of the mystery which has surrounded the ruins of Mitla in Oaxaca, grandiose remains which were found deserted and nigh forgotton when the Spaniards first conquered the country. A handsome large folio volume has recently been published in Berlin (A. Asher & Co.) in which Dr. Eduard Seler presents a study of the singular wall-paintings, portions of which still adorn the inner surfaces on the walls of some of the rooms.

Dr. Seler copied these with fidelity and now reproduces them with an admirable study of their meaning and origin. He is of opinion that the central figure in the religion of the Zapotecs, who are believed to have been the builders of Mitla, was Quetzalcoatl, a familiar and prominent divinity of the Nahuatl tribes. The transfer he explains by the influence which the coast branches of the Nahua exerted upon the Zapotecan priesthood. This thesis is defended with a great deal of learning. Many views of the ruins are given in the full-page plates and numerous mythological figures in the text. The monograph is throughout marked by the thorough scholarship for which the author is so well known among students of American antiquity.

It is a work which our large libraries should not fail to procure.

COMMERCE ACROSS BERING STRAITS.

DR. BENJAMIN SHARP at a recent meeting of the Academy of Natural Sciences, Philadelphia, gave some suggestive information about possible ancient commerce across Bering straits. The distance is about forty miles and in the middle are the Diomede Islands, say twenty miles from each shore.

On the American side there is abundance of wood from which canoes, etc., might be made, but there is none on the Siberian side. The skin boats used by the Siberian natives, made from walrus hide, could not have been sewed sufficiently tight by bone needles to have served to cross the strait. The distance is bridged by ice about once in five years, but the passage across is considered quite dangerous, and nothing but the love of tobacco will induce a native to venture. The inhabitants of the Asian side appear to have been more influenced by the Eskimo arts than the reverse.

These facts and the general bearing of Dr. Sharp's observations are unfavorable to an extended early communication from the Siberian coast to the American.

THE SOCIETY OF AMERICANISTS OF PARIS.

FOR many years French scholars have taken a creditable interest in the study of American subjects, and another evidence in this direction is the formation of a society in Paris devoted especially to this subject. It is entitled the 'Sociétè des Américanistes,' the president being Prof. Hamy, and the honorary president the Duke de Loubat.

It has begun the publication of a journal in large quarto form, the first number of which has forty-one pages and several illustrations. Its contents are two articles, one by Dr. Hamy on the American collections brought together at Genoa on the occasion of the fourth centenary of the discovery of America; the second on the present state of the Fu Sang question. They are both interesting, and it is especially gratifying to see that M. Henri Cordier, the author of the latter, follows the opinion of the eminent Sinologue Professor Schlegel in wholly dismissing the discovery of Fu Sang from the list of possible pre-Columbian voyages to America. (I gave Prof. Schlegel's argument in these notes September 9, 1892).

It is not stated what relation, if any, this new society bears to the long-existent 'Sociètè Amèricaine de France,' which has at times published highly valuable material.

D. G. Brinton.

SCIENTIFIC NOTES AND NEWS.

A DIRECTOR IN CHIEF OF SCIENTIFIC BUREAUS IN THE DEPARTMENT OF AGRICULTURE.

A large number of letters have been addressed to Senator Redfield Proctor, Chairman of the Committee on Agriculture, urging the appointment of a permanant Director in Chief of the scientific bureaus and investigations under the charge of the United States Department of Agriculture. The writers of the letters include the presidents and members of the faculties of Johns Hopkins University and of Yale University, the president of Columbia University, Professors Brewers, Shaler and others most competent to judge of the importance of this measure.

The Joint Commission of the Scientific Societies of Washington has adopted the following resolutions:

Whereas, The work of the Department of Agriculture in the discovery, exploration, development, conservation and proper utilization of the resources of our country is of the utmost importance; and whereas the Department's capacity for originating, procuring and disseminating knowledge of vital importance to farming and other interests, though already large, is capable of much extension in the future; and whereas the results accomplished through the system now in existence have been exceedingly great, and the one thing above all others necessary to increase the efficiency of this organization is a permanent policy with regard to its work and personnel:

Resolved, That the Joint Commission of the Scientific Societies of Washington, composed of the officers of the several scientific societies of the city, comprising in all a membership of nearly 2,000, heartily approves the proposition to create the office of 'Director-in-Chief of Scientific Divisions in the Department of Agriculture,'' to be filled by a broadly educated and experienced scientific administrative officer, holding office during good behavior.

Resolved, That the plan of having a permanent officer in charge of the scientific and technical work under the executive head of a department represents a distinct advance in good government, and is therefore not only of national importance, but if carried out certain to have a beneficial effect upon the scientific standing of Government work in all its relations.

RÖNTGEN RAYS AND THE ROYAL SOCIETY.

The London papers give the following account of the meeting of the Royal Society on February 13th: A paper by Lord Kelvin on The Generation of Longitudinal Waves in Ether described an arrangement for obtaining pressural disturbance through a considerable space of air, accompanied by a very small proportion of ordinary transverse waves. His apparatus would afford the means of exposing sensitive plates to these longitudinal vibrations, and thus might assist in elucidating the nature of the Röntgen rays. A paper by Prof. J. J. Thomson was also read relating to experiments from which he concludes that all substances when transmitting the Röntgen rays are conductors of electricity. A discussion followed the reading of these papers, in which details were given of many experiments on these *X*-rays. Its general effect was, however, to show that, while many interesting points have been noted, the obscurity hanging over the subject had not been appreciably lightened. Considerable differences of opinion were manifest even upon the conditions of the Röntgen experiments. While some advocated the use of very powerful currents, others had been successful with relatively weak ones; and while some were in favor of regarding the phosphorescence of the glass as the efficient source of the rays, others ascribed them to the glow of the electrodes. A new turn was given to the discussion by Captain Abney, who ventured, amid some expressions of dissent, to doubt whether the action of the Röntgen rays on a sensitive plate could properly be described as photographic. He cited several facts which, in his opinion, excluded the theory of direct photographic action in any ordinary sense, and indicated some preference for the view that the Röntgen rays acted by first setting up phosphorescence or action of some unknown kind in the glass at the back of the sensitive film. This view was corroborated by an experiment described by Prof. Dewar upon platino-cyanide of ammonium at low temperatures. This salt, ordinarily fluorescent, only became phosphorescent at the temperature of liquid air. On being exposed to Röntgen rays, instead of the ordinary light, while immersed in liquid air, it showed when the liquid air was poured off brilliant phosphorescence. This proved that whatever might be the nature of the Röntgen rays, they were convertible into the light rays affecting the human eye. A large number of experiments were also described by Prof. Dewar showing that resistance to the passage of Röntgen rays increased with increase of atomic weight. Organic substances were all relatively transparent, following the carbon, oxygen, hydrogen and nitrogen of which they are composed. Mere complexity of structure made no difference, but substitution products showed increasing opacity in the order of the atomic weights of the combined chlorine, bromine and iodine.

ASTRONOMY.

THE January number of the monthly notices of the Royal Astronomical Society contains a very interesting article by Messrs. Christie and Dyson upon the progress of work on the Astrophotographic Catalogue at Greenwich Observatory. It appears that up to the present time no less than 160 plates for the Catalogue have been measured. Moreover, at the present rate of progress 180 plates are being measured annually, and it is estimated that only five or six years will be required to finish the Greenwich zone. The precision of the Greenwich measures is not quite as great as it might be, however, because the authorities there prefer to sacrifice some accuracy in order to expedite the progress of the work. We venture to doubt whether this course is to be commended. It is hardly in accord with the best traditions of the Greenwich Observatory. Probably twelve years devoted to this work, instead of six, would have been sufficient to extract the very highest accuracy possible from these photographic measures.

PROF. ALBRECHT, of Potsdam, has now published in the *Astronomische Nachrichten* the results of his researches on the Variation of Latitude, to which we made reference in a recent number. The former publication took place in the report of the proceedings of the International Geodetic Committee, which is not very accessible to the general astronomical public.

H. J.

GENERAL.

WE much regret to learn that the *American Meteorological Journal* will be discontinued after the forthcoming April number, which ends the twelfth volume. The *Journal* has been carried on at a financial loss on the part of the editors ever since its foundation in 1884, and the present step has been decided upon because there seems no hope that it will become self-supporting, and because the editors do not wish any longer to be financially responsible for a magazine that has not secured the support which it seems to them to have deserved.

THE series of the *Catalogue of Scientific Papers* of the Royal Society, covering the years 1874–83, has been completed by the publication of Vol. XI.

AT a meeting of the Royal Photographic

Society on February 13th it was mentioned that as bearing on the suggestion that the Röntgen rays might resemble ultra-violet rays in possessing germicidal effects, that a cultivation of diphtheria microbes had been subjected to their influence for 12 hours without any sterilizing results.

THE Senate committee on appropriations has concluded its consideration of the agricultural appropriation bill increasing it in the aggregate to the extent of $47,260, and making a total appropriation of $3,262,652. The principal increase is $40,000 for the publication of the special report on the diseases and the feeding of cattle, and the principal reduction is $9,000 on the appropriation of $15,000 made by the House for an investigation of irrigation.

THE Odessa correspondent of the *London Times* writes that the Russian government will send a special scientific mission to observe the total eclipse of the sun which occurs on August 9th. It is remarkable that this total eclipse will be almost exclusively visible throughout the northern part of the Russian Empire, as the line of totality passes from the extreme north of Norway, over Novaya Zemlya, Siberia and Manchuria, to Jesso, in Japan. The mission will be in charge of three astronomers from the Nikolas Observatory at Pulkoff, and leaves Odessa in May by one of the cruisers belonging to the Russian Volunteer Fleet Committee for Vladivostok, whence it will go near the mouth of the river Amoor for observations. The committee has agreed with the government to convey the mission from Odessa to Vladivostok and back again to Odessa free of charge.

DR. LAUGHTON MCFARLANE, professor of surgery at the University of Toronto, died on February 29th, from blood poisoning, contracted while amputating the toes of a patient at the General Hospital a week ago. He was 54 years old.

THE London correspondent of the New York *Sun* states that an Antarctic expedition has been arranged for next winter. It will be partly a trading and a scientific enterprise, and will be under the command of Capt. Svend Foyn, of Christiania. Mr. W. S. Bruce, of the Ben Nevis Observatory, will have charge of the scientific party, composed of himself and four other men. The scientific party will be landed on the Antarctic continent in Victoria Land in January next, and the vessel will then engage in whale and seal fishing, returning to Australia. The following season, in January, 1898, she will return and take off the scientific party, who hope by then to have obtained knowledge of the fauna, flora, geology and topography of the Antarctic region. If found practicable, an attempt will be made to reach the south magnetic pole.

THE Secretary of the Treasury has sent to the Senate the report of Mr. Joseph Murray, a special agent, who has spent seven seasons on the seal islands of Alaska. He states that in 1894, the first year the Paris regulations were in force, 142,000 seals were killed, of which number 60 per cent. were female, all of which left pups to die on the island of starvation. He claims that there were at the close of that season, by the most liberal estimate, not more than 300,000 seals on the islands, whereas when he first went there, in 1888, there were fully 3,000,000.

DR. SELLE and Dr. Neuhauss have exhibited in Berlin colored photographs which have attracted much attention. They are said to be taken by the method used by Mr. Joly of Dublin, three specially prepared plates appropriate for green, red and blue lights respectively being used. The process has been simplified and the time of exposure shortened. Mr. Frederick Ives exhibited before the Royal Photographic Society of London, on February 25th, his stereopticon showing colored pictures.

PROF. ROBERTS-AUSTEN was announced to deliver the Bakerian Lecture before the Royal Society, on February 20th, his subject being the 'Diffusion of Metals.' *Nature* states that Prof. Roberts-Austen has obtained some singular experimental results connected with the mobility of solid metals. Many experimenters in England, especially Prof. Graham and Lord Kelvin, have studied the diffusion of gases and saline solutions, and Prof. Roberts-Austen measured the rate at which certain metals will penetrate each other. He finds that solid gold, for instance, will diffuse into and move about slowly in lead, even at the ordinary temperature of the air, and with considerable rapidity if the lead be warmed, though far from melted. Evidence as to the presence of wandering atoms in a solid possesses much interest now that views as to the nature of metals and other solids have been extended by the discovery that certain rays of light will penetrate them.

THE Postmaster-General has modified the order forbidding the use of the mails for the transmission of specimen germs of cholera or other diseased tissues. By special permit and in mailing packages constructed in accordance with special specifications such germs may be transmitted to United States or municipal laboratories.

ACCORDING to the Boston *Transcript* Mr. Charles B. Cary, curator of the ornithological department of the Field Columbian Museum, has established at Palm Beach, Florida, a museum devoted to the natural history of the State, which is soon to be opened to the public. An excellent collection of birds, reptiles, mammals, fishes, etc., is already in order, and aquaria are to be fitted up for the study of salt and fresh water fishes.

A DEPUTATION has appeared before Mr. Chaplin at the House of Commons to urge that the present English legislation, which practically prohibits the use of self-propelled wagons, be repealed. Mr. Chaplin said that he was in full sympathy with the movement represented by the deputation. A bill was now being prepared by the Local Government Board, and he hoped, with the assistance of Mr. Russell, to carry it without opposition through the House this session.

THE March number of McClure's Magazine contains an article on scientific kite flying by Mr. Cleveland Moffett, describing with illustrations the experiments made by Mr. Eddy.

BY the courtesy of those in charge of the exhibit of the Plant System at Atlanta, the United States National museum has obtained a number of fossils from the Peace Creek phosphate deposit. The greater part of these, including some well preserved teeth, are remains of the mammoth *Elephas primigenius colombi*, and are interesting as showing the large average size of the Florida mammoth. Among the smaller specimens is a fine metacarpus and molar of *Bison latifrons*, the former indicating an animal a trifle over six feet high at the shoulder, about nine inches taller than *Bison americanus*. Two molars of a species of *Procamelus* are probably referrable to *Anchenia minimus* of Leidy and are the first of this species that have come to light.

A RECENT paper by Dr. Gustav Hartlaub, issued as a reprint from *Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen* treats of birds which have recently become extinct or whose numbers have been so reduced that the species seems threatened with extinction. Twenty-three are placed in the first category and twenty in the second, although some of these, like *Notornis mantelli*, are practically extinct. Man and his familiars, cats, rats and hogs, are directly responsible for most of the destruction; and Dr. Hartlaub, in an introductory chapter, treats of the various ways in which it is brought about. References to the more important literature on the species discussed, and a statement of the institutions in which the rarer species are preserved, make the paper particularly valuable to the ornithologist.

DR. LEIDY'S delayed posthumous memoir on fossil vertebrates from the Alachua clays of Florida is now in press, and will appear as a part of the transactions of the Wagner Free Institute of Science.

A NEW monthly journal of entomology has appeared in Tokyo, Japan, under the title Konchū Gaku Zasshi, or Journal of Insect Science. The first number was issued in October last, and is wholly in Japanese, excepting an English title and the statement that the plate represents insects injurious to rice and mulberry.

WILHELM ENGELMANN, Leipzig, announces the early publication of a *Grundriss der Psychologie* by Prof. W. Wundt. The book is awaited with much interest, and should be translated into English without delay. Prof. Wundt is by common consent the preëminent representative of modern psychology. His *Menschen und Thierseele*, published more than thirty years ago, defined the course that psychology has since followed, and his *Grundzüge der physiologischen Psychologie* (Fourth Edition, 1893) is the standard compendium. The volume of Prof. Wundt's writings is almost as remarkable as is their value. He has published large works on physiology, physics, logic, ethics and philosophy, and has in preparation a treatise on anthropological and sociological psychology.

PROF. WUNDT established, in 1883, an Archiv *Philosophische Studien* for the publication of researches in philosophy and psychology, which is now in its twelfth volume. Last year Prof. E. Kraepelin, of Heidelberg, established a similar archiv and now a third archiv, *Beiträge zur Psychologie und Philosophie* has been begun by Prof. Götz Martius, of Bonn. The first number of the first volume contains a preface and an introduction by the editor and four papers all concerned with the brightness of colors. It may also be mentioned that Prof. Münsterberg has published his contributions to psychology in the form of *Beiträge*, and that there is in Germany an excellent *Zeitschrift für Psychologie u. Physiologie der Sinnesorgane*, edited by Prof. Ebbinghaus, of Breslau, and Prof. König, of Berlin. Ten large volumes of this journal have been issued since its establishment in 1890. These contain full reviews of psychological literature and many important papers, those on vision being probably of greater value than all the papers combined that have been published elsewhere on this subject.

THE number of the *Zeitschrift für Psychologie* issued on January 14th contains an index of psychological literature for the year 1894. The index appears somewhat late, but is very complete, especially in regard to publications on the senses. *The Psychological Review* issued, at the beginning of February, a supplement containing a bibliography of the literature of psychology for 1895, compiled by Dr. Livingston Farrand, of Columbia University, and Prof. Howard C. Warren, of Princeton University. The index contains 1394 titles, distributed as follows: General, 136; genetic, comparative and individual psychology, 238; anatomy and physiology of the nervous system, 205; sensation, 125; consciousness, attention and intellection, 180; feeling, 91; movements and volition, 81; abnormal and pathological, 338. This index is also about to be issued in France as part of *L'Année Psychologique*, edited by MM. Beaunis and Binet.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

TO THE EDITOR OF SCIENCE: In your issue of February 21, in an interesting paper on 'Certitudes and Illusions,' Major J. W. Powell has repeatedly referred to an illusion which he describes as a certain tendency to 'reify void'—an ancient, and, as Major Powell has very well said, a disastrous tendency of the human mind. This is the tendency to recognize mere abstractions as realities, and, in consequence, to explain phenomena by referring their source to 'essences' or to some sort of 'substrate,' defined as 'some occult existence unknown and unknowable, which gives to bodies their likeness or unlikeness.' Major Powell very justly condemns this tendency, exemplifies it in a number of cases, suggests explanations for its existence, and rightly declares its inevitable outcome to be a bad metaphysic. So far the present writer cordially agrees with Major Powell.

But, as a humble student of the history of philosophy, the present writer is very sorry to find that Major Powell, influenced by some singular historical 'illusion,' repeatedly refers to one of the best known of modern thinkers, Hegel, as a prominent example of precisely this sort of bad metaphysic. "As the substrate of matter, or reified nothing, is entertained in the minds of some as an entity, so some thinkers make essence a property of this substrate—a nonentity of a nonentity. Chuar (Major Powell's entertaining Indian friend), Hegel, and Spencer reason in this manner."

Major Powell is no doubt an absolute authority as to the views of his Indian friend, and he appears in this particular case to be in no wise unfair to Spencer. But to put Hegel in the same category, to define that lifelong opponent of the 'unknowable,' that merciless dialectical dissolver of all the 'essences,' 'substrata,' and similar entities of traditional metaphysic, as one who, at least in *this* sense, 'reified the void,' well, from the point of view of the student of the history of philosophy such a way of assailing Hegel is in its accuracy similar to a way of assailing Luther's theological views which should hold the reformer up to scorn as a defender of the wicked doctrine of 'justification by works,' and as a blasphemous opponent of 'justification by faith.' One might want to condemn Luther's views; but it would hardly be accurate to talk of 'Luther and the other Papists.' And even so, one is welcome to regard Hegel as a mischievous thinker; but one must not give as a reason that one classes him with those other believers in 'an occult, unknown and unknowable substrate.'

As a fact, by no means all, but certainly a number of Major Powell's own assertions in this valuable paper are theses which every student of Hegel knows to be defended with great energy by the latter thinker. Major Powell well says: "What is the meaning of the word *this?* It may be applied to any constituent of matter, to matter itself, to any body or to any property, and to any idea in the mental world, and its meaning is derived from the context; it has no definite meaning in itself." This is a part of the thesis of Hegel's famous opening chapter of the 'Phänomenologie des Geistes.' And of this thesis in the sequel Hegel makes a use closely analogous to Major Powell's. That to make essence an abstract 'property' of 'the substrate of matter,' is to make essence a 'nonentity of a nonentity' is a thesis so repeatedly maintained by Hegel, in his 'Phänomenologie' (in the third chapter on 'Kraft und Verstand'), in his larger Logic in the second volume, where this 'Bewegung von Nichts durch Nichts zu Nichts' is elaborately discussed, and elsewhere, that Major Powell's failure to recognize the relation of Hegel to this thesis can only be due to a failure to study the habits of Hegel, as our anthropologist would prefer to study those of Chuar, namely, in the 'native wilds' of the thinker himself. The Hegel of whom Major Powell speaks is a product of somebody's 'inner consciousness' and, whoever may be responsible for the dream, all the 'eloquence of the dreamer' cannot make this Hegel an historical person.

Of course, one must beg pardon for laying so much stress upon the mere accidental fact of history in a case like this. Major Powell's general philosophical construction in this paper seems to the present writer despite some minor doubts, essentially sound, and admirably stated. But, as Major Powell himself obviously holds, the history of philosophy is, at least in one aspect, an anthropological study. It is undesirable that even a minor error should, through a chance misstatement, stand upon record as receiving the support of so eminent an anthropological authority as Major Powell.

JOSIAH ROYCE.

CAMBRIDGE, MASS., February 22, 1896.

PROF. C. LLOYD MORGAN ON INSTINCT.

EDITOR SCIENCE: In an account of a discussion on instinct given in SCIENCE of February 14th, Prof. Morgan is reported thus: "He described his own interesting experiments with chicks and ducklings, and held that these and other evidence tend to show that instincts are not perfected under the guidance of intelligence and then inherited. A chick will peck instinctively at food, but must be *taught to drink.* [Italics mine.] Chicks have learned to drink for countless generations, but the acquired action has not become instinctive."

In one of a series of papers now in the press on 'The Psychic Development of Young Animals and its Physical Correlation,' I have given in detail an account of a study of the pigeon and the chick. It so happens that this very question of drinking by chicks has been especially noted, and I find a record of one observation to the effect that a newly hatched chick pecking at the drops on rim of a vessel containing water accidentally got its beak into the liquid, whereupon it at once raised its head and drank perfectly well in the usual fashion for fowls. Was this by teaching or by instinct?

Later the chicks seem to peck and drink, sometimes on seeing the mother do so. The act seems to be in such a case a sort of imitation so far as its inception is concerned. But will any one contend that that first act of drinking referred to above was other than instinctive? Again, when a chick first drinks on its beak being put into water, can the act be considered as the result of teaching? Is the chick so intelligent as to carry out an act so complex in such a perfect way as it does on the very first occasion as the result of 'teaching?' Surely no one will deny that sucking is an instinctive act, yet a newly born mammal sucks only when its lips come *in contact* with the teat. Is not the case very similar with the chick? The only difference is that the chick is slower to *recognize* water than food, but as soon as the beak touches water it drinks and there is no teaching about it. Considering how seldom a fowl drinks, yet pecks all day long at particles of food, it is not surprising that the chick is slower to recognize water (drink) than food. But it is one thing to say that a chick learns to recognize drink and another to affirm that it learns to drink. The process of drinking is quite as perfect as that of eating from the very first, if not more so, for a chick at first often misses what it pecks at and fails to convey the object into its mouth in other cases, though it may touch it.

The view that instincts are perfect from the first and undergo no development from experience, I believe, after much observation, to be as erroneous as it is ancient.

Instinct is never, perhaps, perfect at first, and so far as I can see, could not be owing to general imperfect development in the animal of motor power, the senses, etc. A young puppy will suck anything almost that can pass between his lips, as a chick will peck at any light spot or object if small, be it food or not. My own records abound in observations that amply prove the position taken, and while my experiments and observations on birds are in the main in accord with those of Prof. Morgan so far as I know them, I cannot but believe, if I have correctly understood his views as reported at the New York meeting, that he has misconceived or overstated the case under consideration.

The subject of heredity is too large to enter upon now. I may say, however, that my researches in comparative psychology and especially in that part bearing perhaps most closely on the question, psychogenesis, do not incline me to believe any the more in that biological *ignis fatuus*—Weismannism.

WESLEY MILLS.

McGILL UNIVERSITY, MONTREAL.

[Professor Morgan's observations agree with those of Professor Mills and others. A chick swallows water instinctively, but must be taught to drink by example or by accident. The chick might die of thirst in the presence of water, as the sight of the water does not call up the movements of pecking at it, as do food and other small objects. The mother hen replaces natural selection, and the action, though continually practiced by the individual, has not become instinctive, because it has not a selective value. Professor Morgan's argument seems to be satisfactory. If actions which occur but once in the lifetime of the individual (*e. g.*, the nuptial flight of the queen bee) are thoroughly instinctive, and others which are practiced continually by the individual do not become instinctive in the race, we can scarcely regard instincts as hereditary habits, but must rather attribute them to variations, fortuitous or due to unknown causes, and preserved by natural selection.—THE WRITER OF THE NOTE.]

THE CHANCE OF OBSERVING THE TOTAL SOLAR ECLIPSE IN NORWAY.

EDITOR OF SCIENCE: As unusual facilities are being offered to visit northern Norway to observe the total solar eclipse on the 9th of next August, of which many American and English astronomers and tourists will doubtless take advantage, it seems desirable to make known the following data relating to the cloudiness, and the consequent probability of seeing the eclipse there. They have been communicated to me by Prof. H. Mohn, director of the Norwegian Meteorological Institute, who prepared them for the Swedish Astronomical Association.

Vadsö, which has been recommended as the most accessible station near the central line of totality and will be the rendezvous of several parties, is situated in Latitude 69° 52′ North and Longitude 29° 45′ East of Greenwich. According to the British Nautical Almanac, the total phase, lasting 1m 47s, here occurs at 15h 58m Greenwich time, or 5h 55m local mean time, which is 2 hours after sunrise. The sun's altitude is 15°.

Professor Mohn writes: For Sydvaranger, the nearest place to Vadsö at which meteorological observations have been made, the amount of cloud on a scale of 0 to 10, and the chance in percentages of its occurrence are as follows:

August 8th, 8 P. M.		August 9th, 8 A. M.	
Amount of Cloud.	Chance.	Amount of Cloud.	Chance.
10	45.5	10	45.5
8	13.7	9	9.1
7	4.6	8	4.6
5	4.5	7	9.1
3	9.1	6	4.5
2	4.5	4	4.6
0	18.2	3	4.5
		2	9.1
		0	9.1
	100.1		100.1

"In Vadsö there is a telegraph station, and time signals are to be had from the observatory in Christiania. The latitude and longitude have been determined with all possible accuracy. Sydvaranger lies on the south side of the Varangerfjord and Elvenes is the name of the posting station. Vardo, lying on the north side, is not to ber ecommended, having too often fog or clouded sky. In the interior of Finmarken the sün is lower than at Varangerfjord."

Although the astronomical conditions of low altitude of sun and short totality are not good, yet the meteorological conditions just noted compare favorably with those of stations in Japan, where the eclipse occurs later in the day and totality lasts longer. As a basis of comparison for the chance of clear weather, it may be stated that here at Blue Hill, Mass., near the coast, at 8 A. M. in August the average frequency of cloudy weather (sky 8 to 10 tenths covered) is 50.0 per cent. and the average frequency of clear weather (sky 0 to 2 tenths covered) is 32.3 per cent.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, February 20, 1896.

THE RÖNTGEN RAYS.

The following fact regarding the X-rays of Röntgen may be of interest:

I have found that it is possible to obtain a photographic image by these rays using a 'pinhole camera,' having the aperture pierced in a piece of sheet lead backed with aluminum. The Crookes tube was illuminated by discharges from a Thomson high-frequency coil. The photographs taken in this way show very distinctly the two electrodes, while the glass bulb, which appeared to be brightly illuminated to the eye, is scarcely perceptible. It would appear from this that nearly, if not all, the so-called X-rays proceed directly from the electrodes of the tube and not from the glass where this is acted on by the cathode-rays. It likewise affords further illustration of the rectilinear motion of the X-rays. Experiments are in progress with a broken current and also to study the effect of a magnetic field.

Previous observation had shown that the photographic effects were produced equally whether the cathode rays impinged upon the glass or upon other phosphorescent material (*e. g.*, arragonite) within the tube. It has also been noticed in experiments in this laboratory that the appearance of the tube to the eye affords no criterion of its efficiency in producing the X-rays; tubes showing but little fluorescence of the glass composing them often giving admirable photographic effects, which in some cases are obtainable even from a low-vacuum Geissler tube. But the rays producing photographic effects always appear to produce strong flourescent effects on platino-cyanide of barium, so that the fluorescence of this affords an indication of the photographic efficiency of the radiations emitted from the tube.

RALPH R. LAWRENCE.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON, February 26, 1896.

RÖNTGEN RAYS PRESENT IN SUNLIGHT.

IN the course of a series of experiments on the so-called Röntgen or X-rays, the undersigned have secured evidence of the presence of these rays in sunlight, and have been able to reproduce many of the phenomena ascribed to the X-rays, without the use of vacuum tubes or any other source of light or energy than direct sunlight.

Dr. Egbert was led on February 22d to place in a photographer's printing frame, an ordinary sensitive plate (Seed's No. 26), upon which was superimposed a positive lantern slide, and on this a shield of aluminium; which was then exposed to the direct rays of the sun for two hours, and the plate developed, when it was found that the aluminium shield had been transparent to some agent which had produced a photographic effect; although the sensitive plate was completely in the dark within the printing frame and thoroughly protected from light rays as generally understood. Apparently, however, the plate had been over-exposed, and it seemed that better results might be obtained by shorter exposures. Therefore other plates of the same kind were exposed by us for gradually decreasing periods, under negatives and positives, and shields, respectively of aluminium, hard rubber, black cardboard and double thicknesses of opaque needle paper.

Positives were obtained in each case resembling those obtained by the photographer with ordinary methods, in some cases the exposures being as brief as ten minutes.

Shadowgraphs ('skotographs,' or 'skiagraphs') were also produced by the method employed by Prof. Röntgen, except that the source of energy was the direct sunlight in place of the rays from a vacuum tube, *i. e.*, coins placed upon the aluminium shield produced shadow prints on the sensitive plate.

It is obvious that these experiments prove the presence in sunlight of the peculiar rays described by Prof. Röntgen, or of others possessing the same properties, namely, the power of penetrating substances opaque to ordinary light rays.

Prof. Röntgen states, in the second clause of his article (as translated and printed in SCIENCE of February 14th, p. 227,) 'that some agent is capable of penetrating black cardboard, which is quite opaque to ultra-violet light, sunlight or arc-light.' If this statement refers to sunlight *in toto*, including the visible and invisible rays, it is evidently contravened by our experiments, which demonstrate beyond a doubt the existence of an 'agent' in sunlight, which accomplishes the work of the 'X-rays.'

Prof. Röntgen refers to the possibility that the effect is due to a fluorescence produced in the material of the sensitive plate. One of our experiments seemed to point to the correctness of this hypothesis. Fixed photographic prints on albumin paper placed between the aluminium shield and the sensitive plate gave corresponding negative effects; but the space covered by these prints was evidently more intensely acted upon by the rays than other parts of the plate covered only by the aluminium. Should fluorescence be produced by these rays in silver emulsions, it would perhaps explain the phenomena. Prof. Röntgen further states that silver in 'thin' layers allows the rays to pass; but we have shown that some of the rays are partially stopped by the exceedingly thin film of silver in the ordinary photographic negative.

It is obvious that the discovery of these rays in sunlight opens up an entirely new field for experiment and is of the highest practical importance to all photographers.

We hope to supplement this preliminary statement by a presentation of the results of our attempts to solve a number of interesting problems that have been suggested.

CHARLES S. DOLLEY,
SENECA EGBERT.

[Results somewhat similar to those given by Drs. Dolley and Egbert have been announced by M. Gustav Le Bon, Prof. S. P. Thompson and others. The conditions, are, however, so complex that it is difficult to eliminate sources of energy other than the Röntgen rays. Careful experiments at Columbia College have not detected any penetration of thin ($\frac{1}{100}$ inch) sheets of aluminium by sunlight, though ebonite and wood of considerable thickness are penetrated by ordinary light. Ed].

RÖNTGEN RAYS FROM THE ELECTRIC ARC.

PROF. S. P. THOMPSON is reported* to have discovered the Röntgen rays in the radiations emitted by the electric arc, and to have succeeded in getting excellent shadow pictures with them. The present writer had carried out the following experiments before seeing the report of S. P. Thompson's work, and had reached conclusions opposite to those reported of Prof. Thompson.

Very rapid (Carbutt's 'Eclipse 27') and medium (Carbutt's 'Orthochromatic 23') plates, placed in ordinary holders, were laid in deep lead trays and masked with two to five thicknesses of black cardboard, including the card-

* London, *Electrician*, January 24, 1896. Digest in the *Electrical World* February 15th.

board slide of the plateholder. Bits of sheet aluminum ($\frac{1}{4}$ mm. thick) and of sheet lead ($\frac{3}{4}$ mm. thick) were laid upon the cardboard slide of the plateholder. Two to five hours' exposure to a 900 Watt arc at a distance of 25 cm. produced no perceptible effect.

The bits of sheet metal were then for convenience placed next to the gelatine film and the plates, masked with two thickness of black cardboard, were exposed to the arc for three hours at a distance of about 12cm. The plates become quite hot, about 80°C. after development the action was found to be quite strong where the plate was not screened by the bits of metal. The bits of metal, each several square centimeters in area, screened the plates about equally. The portions of the films under the bits of metal showed very faintly the texture of metal surface, as if by reflection.

The plates were then arranged so as to obviate excessive heating by ventilation, and masked with two thicknesses of black cardboard and two to four thicknesses of mask paper, the bits of sheet metal being placed outside the cardboard slide of the plate holder as at first. Three hours' exposure at a distance of 15 cm. from the arc produced no perceptible effect.

The arc was then arranged to play between zinc and carbon, taking about ten amperes at thirty-five volts. The plates arranged as described in the previous paragraph were exposed to this zinc arc for two hours at a distance of about ten centimeters. The zinc rod was cathode for about one hour and anode for about one hour. No perceptible effect was produced.

It seems justifiable to conclude from these experiments that Röntgen rays are not given off in any abundance by the electric arc, and that they are not of the same nature as the ultra-violet of the spectrum, or at least that they are not of the same nature as the ultra-violet, which is present in any abundance in the light emitted by the electric arc between carbon electrodes or between zinc electrodes.

In demonstrating the presence of Röntgen rays it is necessary in every case to exercise the greatest care in the rigid exclusion of every other agent capable of affecting the sensitive plate, such as ordinary and ultra-violet light, electric charge acting directly upon the film, mechanical pressure, high temperature, etc. These rays and the cathode rays are distinguished among all other actinic radiations by the facility with which they pass through metals and from each other by their different behavior in the magnetic field, as appears from Röntgen's paper. W. S. FRANKLIN.

AMES, IOWA.

SCIENTIFIC LITERATURE.

Grundzüge der Marinen Tiergeographie. Anleitung zur Untersuchung der geographischen Verbreitung Mariner Tiere mit besonderer Berücksichtigung der Dekapodenkrebse. Von DR. ARNOLD E. ORTMANN, in Princeton, N. J., U. S. A. Mit 1 Karte. Jena, Verlag von Gustav Fischer. 1896. Pp. 96. M. 2. 50.

This is an excellent contribution to zoögeography, which ought to be in the hands of everybody interested in the fascinating questions of animal distribution. A great number of highly interesting points are also discussed, important for the biologist and geologist.

The principal aim of this work, the author states in the introduction, is to call the attention of the scientific world to the highly interesting study of the distribution of marine animals hitherto greatly neglected. Before all, the principles had to be established, according to which the distribution of marine animals has to be examined; in doing so it was necessary to discuss the general principles of animal distribution. Since the question of the distribution of species is most intimately connected with that of their origin the latter had to be examined, and the result is reached that the principle of separation or isolation is one of the most important factors. As an example of distribution Dr. Ortmann selected the group of decapod crustaceans, of which he has made special studies. He finishes his introductory remarks with the very pertinent sentence that without extensive and critical systematic preliminary work fruitful geographical studies are absolutely impossible.

The work is divided into seven chapters. The first chapter gives an historical review of the development of zoögeographical science. He distinguishes three periods.

1st *period.* The oldest attempts of A. Wagner, L. Agassiz, Dana and Schmarda.

2d *period.* To A. Agassiz and Wallace. The period of the discussion about the number of zoögeographical regions, and the first attempt to lay a scientific basis for zoögeography.

3d *period.* From Wallace to Heilprin, Trouessart and Döderlein. The period of the special researches on single groups of animals, with more or less considerable acceptance of the principles of Wallace; full treatment of single groups.

At the end of the chapter Ortmann refers to a very important paper of Pfeffer: Versuch über die erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unserer Thierwelt, Hamburg, 1891, which he considers as possibly the best ever published on zoögeography; he also refers to the new work of J. Walther. Einleitung in die Geologie als historische Wissenschaft I. Theil. Bionomie des Meeres. Beobachtungen über die marinen Lebensbezirke und Existenzbedingungen. Jena. 1893.

The second chapter treats of the most important physical life conditions, the life regions and the facies ('Bionomy'). Ortman distinguishes the following life regions.

1. The terrestrial region of *Terrestrial* (continental).
2. The fresh-water region or *Fluvial.*
3. The litoral region or *Litoral.*
4. The pelagic region or *Pelagial.*
5. The abyssal region or *Abyssal.*

After this the adaptations of the organisms to the life regions are discussed. The organisms are divided into two groups according to their dependence on the bottom * (Substrat). Animals which are dependent on the bottom and are unable to free themselves from it constitute the Benthos (Haeckel); animals which are not dependent on the bottom, those which during their lifetime never need to come into connection with the coast or the bottom of the ocean constitute the *Plankton* (Haeckel). Among the benthonic animals three groups are distinguished according to their more or less intimate connection with the bottom; first, *sessil benthos*, attached to the bottom, receiving food from outside; second, *vagile benthos*, creeping and running on the bottom to obtain food; and third, *nectonic benthos*, able to swim, able to leave the bottom at times, but always forced to return to it. The nectonic condition forms the transition to the *typical plankton*, which is independent of the bottom. The three groups of *benthos* are characteristic for the litoral and abyssal. The true *plankton* is characteristic for the pelagial.

The condition of the facies is of course of the highest importance for the organism. Ortmann distinguishes *primary* and *secondary* facies, the first is formed only by anorganic, the second also by organic material; but of course there are many combinations of the two. Each life region, however, with the exception of the open sea, has its special facies. The basis of the continental facies is the geological structure of the continents. Of great importance are the physiographic differentiations of the land.

In the fluviatile life regions the conditions are similar, but here much depends on the different nature of the medium; that is, the nature of the course of the water—lakes, rivers, etc.

The *litoral*, through its numerous relations to the land, and its frequent dependence on the nature of the latter, shows very numerous differences in its facies.

The facies of the *abyssal* consists of the smallest disintegrated products of minerals and rocks, accompanied by remains of terrestrial and marine organisms.

The *pelagial* has no facies. Peculiarities are produced, however, in the sargassum-masses.

The third chapter is headed: *Distribution of Animals. Increase and prevention of distribution. Means of Distribution.* It begins with the definition of the principle of separation and migration, which is of the greatest importance for the understanding of the processes connected with the origin of species and which is inseparable from zoögeography. This important principle was especially studied by Moriz Wagner, but, as Ortmann very properly states, has been misunderstood by many authors, or not accorded its full value. In order to estimate correctly the value of this principle, and in order

* Brooks, William K. Salpa in its Relation to the Evolution of Life. Stud. Biol. Labor. Johns Hopkins Uni., Vol. V., No. 3, May, 1893. (This paper was unknown to the author.)

to show that without this principle of isolation differentiation of species is unimaginable, Ortmann gives his view on the origin of variations and their modification in different species. In regard to the origin of variations he follows those authors which explain variation by direct adaptation of the surroundings (I would prefer to say by the direct influence of the surroundings). He is entirely opposed to Weismann's idea, according to which variation originates by Amphimixis, *i. e.*, the union of two elements (germplasmas of different kind). His principal objection is that Weismann, in order to explain the origin of variation, introduces the principle of Amphimixis, but allows this to operate with material already varied, the difference of the germplasmas. Weismann, in order to explain the origin of differences, takes for granted their preëxistence. For this reason alone Amphimixis as the source of variation is inadmissible. On the other hand it is known by experience that amphimixis, if operating with different material, will not produce new, but will unite together existing differences, especially if the different material is already similar and closely related. In this connection he refers especially to a paper by Pfeffer: Die inneren Fehler der Weismann'schen Keimplasma-theorie. Verhandl. Naturw. Ver. Hamburg (3) I., 1894, which seeems to be very little known.*

The two factors which form the basis for the process of the formation of species are according to Ortmann: 1, the adaptability of the organisms themselves to the external conditions, and 2, the possibility of the inheritance of the characters thus acquired. To these a third factor is added, *natural selection.* Natural selection operates in such a way that out of the number of existing forms those are exterminated which are unfavorably placed. It is not a selection of the fit, but a destruction of the unfit. By this destruction of the bad individuals the average of the totality is raised; that is, the average of the characters of the forms is changed quite gradually in a definite direction, determined by the external conditions existing at that moment. This process is called *transformation of species* (Pfeffer), or *mutation* (Waagen, Neumayr, also Scott, W. B., On Variations and Mutations, Am. Journ. Sc., 48, 1894, pp. 355–374).

It has been entirely overlooked by Weismann and many others that the process of mutation of *one* species or *one* group of forms is by no means identical with the formation of *new, contemporaneous different* species. Natural selection can only operate in such a way as to improve or modify, in the course of time, a series of forms or a species, as soon as the conditions of existence are changed; out of *one* form another can be produced by selection, but never *two.* The divergency of the directions of mutation, the origin of separate forms from *one* ancestral form, natural selection can never explain. This is only conceivable if the conditions of existence are also differentiated; that is, if they appear different in different regions of the earth at the same time, so that the ancestors of one form living in these different locations are subjected to special conditions. A successful effect of the different life conditions, however, can only be imagined, if the organisms are forced to remain *permanently* in these conditions, if they are prevented from migrating from one region of definite conditions of existence into others with other conditions. Therefore we have, as the *fourth* and most important factor in the formation of different species, the *separation* in *space* or *isolation.* I think everybody who has ever undertaken to study the geographical distribution of certain genera will agree with these views. I have emphasized it frequently,* as is fully admitted by Ortmann. The isolation prevents the cross-

* There are some other papers by G. Pfeffer, which are of great importance in these questions: Die Umwandlung der Arten ein Vorgang functioneller Selbstgestaltung. Verhandl. Naturwiss. Verein. Hamburg (3) I., 1894, 44 pp., and Die Entwicklung. Eine naturwissenschaftliche Betrachtung. Berlin. R. Friedländer und Sohn. 1895, 42 pp.

* Baur G. Das Variiren der Eidechsengattung Tropidurus auf den Galapagos Inseln. Biol. Centralbl. X. 1890, pp. 475–483. Leuckart. Festschrift 1892. pp. 259 ff. On the origin of the Galapagos Islands. Am. Nat. 1891., pp. 217–229, pp. 307–319. Ein Besuch der Galapages Inseln. Biol. Centralbl. XII. 1892. pp. 221–250. The Differentiation of Species on the Galapagos Islands and the origin of the group. Biol. Lect. Mar. Biol. Lab. Woods Holl 1894. Boston, 1895, pp. 67–78.

ing of the forms, and is fully comparable to artifical selection.

Ortmann ends his discussion with the following résumé: From these considerations it becomes evident that four factors contribute to the formation of different species: 1. *Adaptation to external conditions produces variations.* 2. *The inheritance of these adaptations fixes the variations and shapes groups of forms morphologically related.* 3. *Natural selection modifies the groups and produces mutation in a certain direction.* 4. *The isolation of groups produces differentiation in the direction of mutation and therefore formation of new species. All these 4 factors must coöperate; none can be absent, and none is possible without the others.*

Amphimixis operates in a conservative manner on the average characters, thus leveling the variations, which are capable of preservation, and which are not, therefore, injurious.

The principle of separation has an important bearing on zoögeography, since it follows that species must originate in isolated localities; they are bound to centres of origin. We want to know the place of origin of a given species which at present lives in a certain locality. Did it originate or immigrate there. From this it follows, that in the fauna of each single locality we have to distinguish: First species which originated there, *autochtons*, and second species which immigrated from other localities, *Immigrants*. A third group are the *relicts*, which formerly had an extensive distribution, but are now restricted to a few points. The decision of the nature of a certain animal form in a certain region, whether autochton, immigrant or relict, can only be given by systematics, and here the slightest detail must be considered. At this point zoögeography is not only most intimately connected with systematics, but entirely dependent on it.

The following pages discuss the law of the continuity of the areas of distribution, and the increase and prevention of distribution.

According to the principle of migration, the single animal forms can only extend to such regions as are in connection with the original center: This *is the law of the continuity of the areas of distribution.* It is a well known fact that the range of every species extends over a number of localities, which are separated from each other by smaller or larger gaps; these gaps, however, must not be so large that they could not be surpassed by the species in question; thus a continuous communication of the inhabitants of the single localities in which the species is found is possible. Only when this is the case can we speak of a *continuity of life conditions.* As soon, however, as this continuity is interrupted in such a way that it prevents the communication of the species, a *barrier* is formed which prevents its further extension. Continuity of life-conditions increases the distribution of animals; their interruption prevents it.

There are especially two factors which are of importance in this connection, for the first time clearly defined by Pfeffer, the *climatological* and the *topographical;* a third one has been added by Ortmann—*the biological.*

The effect of climatic conditions on the distribution of animals.

A uniform distribution of animals in their life districts presupposes uniformity of the climatic conditions, since all animals are highly dependent on temperature. The importance of the conditions of temperature was first pointed out by Dana; he considered the minimal absolute altitude which the animals need as the most important point, and constructed his *Isocrymes*, lines of equal lowest temperature. That the principle is not correct is generally admitted at present, and it has been replaced by another one. It is not so much the absolute altitude of the temperature which influences animal life, but it is the *Amplitude*, the amount of oscillation, since the temperature in the same locality oscillates according to the seasons. Möbius therefore has distinguished *stenothermous* and *eurythermous* animals. Stenothermous animals are unable to stand considerable oscillations; they are bound to a more uniform temperature; eurythermous animals are not affected by considerable changes. The fundamental difference between the marine and continental conditions of temperature is thereupon discussed. On the continents we have high amplitudes, the surface temperatures of the ocean being more uniform. Since the terrestrial animals are adjusted to high amplitudes—being eurythermous—their distribution is not so much influenced by the climatic differences; it seems, therefore, that *the topographical factors in the distribution of terrestrial animals are of more importance than climatic factors.*

The matter is different in the case of marine animals. The oscillations of temperature are not so extensive as those of the continents, and the amount of these oscillations is very different in different latitudes. Ortmann arrives at the following conclusion from the given data: *In the equatorial regions of the oceans a nearly uniform temperature prevails with only limited oscillations; these oscillations increase with the latitude, reach their maximum in the temperate and decrease again to a smaller amount in the highest latitudes, the polar regions.*

The conditions on the surface of the oceans are of course different from those at some depth, and the coasts have also an influence on the litoral region. The oscillations of temperature in the sea will appear especially in the upper layers which are exposed to the direct influence of the sun, that is principally in the litoral and pelagial. With increasing depth they decrease and are reduced to a minimum in the deep sea. As is well known, the abyssal has a very constant low temperature, and therefore we cannot expect any climatic effect on the distribution of its animals.

Effects of the topographical conditions on the distribution of animals. Combination of the climatic and topographic principle.

The *continental* is composed of a number of completely separated landmasses; which approach each other closely in the northern hemisphere, but which are always separated by the sea. This character is fundamental and conditions a different development of animals in the separate land areas. These topographical conditions are more important than the climatic differences. A similarly extensive topographical segregration is seen in the *fluvial*; it is even still more highly differentiated, consisting of a very great number of topographically isolated portions, which very often may be connected with one another. These two life zones are distinguished from the marine zones, which are characterized by a more or less complete continuity. The least continuity is shown in the litoral, but even this zone is in uninterupted connection along the coasts of the continents. In the abyssal and pelagial zones the continuity is complete.

We can, however, distinguish regions topographically separated in the litoral and pelagial, but this is only possible by the combination of the climatic and topographical conditions. In high northern latitudes the continents approach each other very closely; in the southern hemisphere they are removed from each other. In the northern hemisphere, where the continents are close together, the litoral is continuous; in the southern hemisphere the pelagial has its broadest connections around the southern end of the continents; in both these regions totally different conditions of temperature exist from those of the tropical regions. They form therefore two completely isolated regions, separated by the tropical portions of the litoral. These are formed by four large divisions, one on each side of the great land areas, the old and new world. The *pelagial* is only divided into two portions, the Atlantic and Indo-Pacific, separated topographically by the two large landmasses. It is a very important point that this topographical separation of the tropical parts of these two life regions is only made possible by the climatic differentiation of their circumpolar parts.

The *abyssal* is not affected by such climatic differences and cannot be separated topographically.

Effect of the biological (biocœnotic) conditions on the distribution of animals. Since migration takes place in all directions the result will be a conflict between the different immigrants. Since in the resulting competition some forms supplant others, we may use the expression that the latter are checked by biological obstacles. Especially in those cases the struggle for existence is seen in its clearest form.

The chapter concludes with some remarks on the *means of distribution of animals. Active* and *passive* means are distinguished.

The means of distribution are different in the different groups of animals; therefore, these groups must show differences in their actual distribution. Many animals have different means of distribution in different stages of their life history. Each single group must be treated by itself for the determination of its distribution. Every attempt to treat uniformly animal groups, differing in this respect, or even the attempt to compare them, is destined to be a failure.

The fourth chapter treats about *the marine zoögeographical regions.* Ortmann constructs these regions according to the most important physical conditions which are of value to the geographical distribution of animals. It is necessary to examine the relations of each group of animals and each species of the general laws of distribution, and it is, therefore, the aim of scientific zoögeography to solve the question how the single animals behave towards the general laws. From this it follows that for the determination of general regions of distribution we have to consider separately each life region, since the fundamental physical conditions are totally different in every one of them.

The physical regions of the litoral life zone. The principal characters of the litoral are: 1, presence of light; 2, presence of the bottom; and 3, the presence of the medium, *i. e.*, the sea-water. The litoral follows generally the coasts of the continents, and extends only over that part of the sea which borders the coast. The distance is of course determined by the inclination of the sea bottom. The limit is the depth to which daylight is able to penetrate, that is about 400 m. Besides there are litoral regions around each island or group of islands. The close relation of the litoral to the land produces, of course, a great difference in the facies, and, therefore, we have very different conditions of existence. The most important conditions are the climatic differences. The litoral is divided by Ortmann into the following regions:

1. Arctic Region.
    a. Arctic circumpolar subregion.
    b. Atlantic boreal subregion (with two local faunas).
    c. Pacific boreal subregion (possibly also with local faunas).
2. Indo-Pacific Region (very uniform).
3. West American Region (very uniform).
4. East American Region (probably with local faunas).
5. West African Region.
    a. Mediterranean subregion.
    b. Guinea subregion.
6. Antarctic region (numerous local faunas).

The abyssal life regions.

The principal characters of the abyssal consist in the complete absence of sun light, uniform cold temperature, relative state of rest of the medium and the slightly differentiated character of the facies. In its low temperature the abyssal approaches the Arctic litoral. The extension of the abyssal is enormous; it covers the whole bottom of the oceans. Topographically the abyssal of the whole earth is continuously connected. Therefore, it is impossible, so far, to divide the abyssal into different regions.

The physical regions of the pelagic life zone.

The pelagial resembles the litoral in the presence of sun light, but differs from it in the absence of the 'bottom.' In regard to temperature it is also more like the litoral. There is more variety than in the abyssal. The horizontal extension of the pelagial agrees nearly completely with the abyssal, and is therefore topographically uninterrupted.

But here the climatic conditions act in a manner similar to those of the litoral. In the equatorial regions we find the surface of the water of equally high temperature. Towards the poles the temperature becomes lower, and the amplitude of the oscillations increases; still farther towards the poles, the temperature of the water becomes again more uniform but cold.

The Pelagial is divided by Ortmann into four regions:

1. Arctic Region.
    a. Arctic-circumpolar subregion.
    b. Atlantic-boreal subregion.
    c. Pacific-boreal subregion.
2. Indo-Pacific Region.
3. Atlantic Region.
4. Antarctic Region.
    a. Notal*-circumpolar subregion.

*Ortmann was unable to trace the name *notalian*, whose original appliance by Gill was introduced in 1884 in a very interesting paper. The Principles of Zoögeography, a presidential address delivered at the third anniversary meeting of the Biological Society of Washington, January 19, 1883. Proc. Biol. Soc. Washington, Vol. II., 1882-1884, pp. 39. Washington, 1884.

b. Antarctic-circumpolar subregion.

The Pelagial of the Indo-pacific Region is completely isolated from that of the Atlantic Region by the notal-circumpolar subregion.

The fifth chapter is a very important one; it discusses the influence of the earth's geological changes on the distribution of animals, and the geological change of the climatic, topographical and biological conditions. The present condition of the animal kingdom is the final result of a series of geological changes, and the present distribution is caused by the conditions of former times. We know through paleontology that in former periods animals existed in regions in which they are missing to-day; the geographical distribution has, therefore, changed in the course of the earth history. There is no longer any doubt that a change in the distribution of water and land, in the climate and in the biological conditions, has taken place; the question is: how extensive was this change?

Climatic changes: The view of Neumayer that even during the Jurassic period three climatic zones existed, an arctic, temperate and equatorial, Ortmann rejects with Heilprin and Pfeffer. His view is the following: As far as our present knowledge reaches, we may assume, with certainty, that only during the course of the Tertiary did climatic differences develop. The principal point of this differentiation consists in the separation of a zone around the poles, in which the seasons of the year underwent a change in the height of temperature. This change increased until there was a sharp contrast between the new and the original uniform conditions of temperature which remained towards the equator. Before this climatic separation appeared, certainly in pre-Tertiary time, a uniform tropical climate existed on the earth, and no climatic regions could be developed in relation to the distribution of animals.

Topographic changes:

Ortmann is opposed to the theory, especially advocated by Wallace, of the consistency of continents and oceans since the oldest times. It has often been attempted, he says, to reconstruct the continents existing in former geological periods. The means of doing this consist first in the tectonic method of geology, and second in the data from the distribution of animals and plants. I shall not go into detail concerning these questions, which have been discussed lately very frequently (Blanford, Yukes-Brown, Ihering, Baur). I fully agree with Ortmann that the distribution of land and water has very considerably and frequently changed during geological times, and that these changes must have had an enormous effect on the distribution and differentiation of the fauna. The same holds good of the fluvial, the life zones of the fresh water.

But it is quite different with the marine life-zones. The litoral follows essentially the lines of the continents. All changes affecting the continent affected also the litoral. We are bound to accept for the litoral a topographical continuity existing from the earliest times. Therefore it is best to assume that in Pre-Tertiary time, before climatic differences existed, the litoral was in complete climatical and topographical continuity; and that there was no possibility of separation into regions according to climatic and topographic differences. With the appearance of the climatic differentiation in the Tertiary the conditions of the litoral changed, and they gradually reached the form in which they appear to-day. At first, however, there existed a considerable difference from the present conditions, at any rate through one part of the Tertiary times, which had its cause in the nature of the circumtropical girdle. There was still a connection between the Atlantic and Pacific, South and North America being still separated. But at the poles the Atlantic and Pacific were already climatically differentiated. There existed also probably a connection between the Mediterranean and Indian Ocean. If this was really so, there were present perhaps from the beginning to the middle of the Tertiary *two* large groups of tropical litoral; an *American* and a *Mediterranean-Indo-Pacific* region. Possibly the West African region belonged to the American litoral.

From this condition the present distribution of the litoral and its regions developed. The Mediterranean was separated from the Indian Ocean and acquired connection with the Atlantic; the Isthmus of Panama separated the East American from the West American litoral.

Especially the latter process was a relatively recent one, but it existed long enough to produce differences in the two faunas. The former conditions on the other hand can be recognized very frequently in the present distribution.

Probably the *abyssal* life-zone was formerly not so extensive as to-day. It is probable also that during periods before a decrease of temperature at the poles the conditions of temperature were quite different from our present ones. The *abyssal* may therefore be of relatively recent date.

The *pelagial* must be very old, certainly as old as the litoral and continental. It was quite continuous in former times. With the climatic differentiation of the poles a corresponding differentiation of the pelagial took place; the circumtropical belt remained for some time continuous. The separation into the Atlantic and Pacific region was produced by the Isthmus of Panama. This differentiation is very recent, and the pelagial of the two new regions are exceedingly similar.

The chapter concludes with some remarks on the biological (biocœnotic) changes of the earth history.

The sixth chapter is devoted to the *Bionomy and geographical distribution of the Decapoda.* Dr. Ortmann is an authority on this group of crustaceans. An exhaustive essay on the geographical distribution, he says, is at present not possible, since some of the smaller groups have not been sufficiently studied; but he thinks it feasible to give a general view of the bearing of the *Decapoda* on the points discussed in the former chapters.

In many ways, he says, the *Decapoda* are a typical group for zoögeographical studies. Here all the possibilities of bionomic conditions are found, and they therefore constitute an especially good example of distribution. The ancestors of the Decapoda were nectonic animals, which were dependent on the bottom, could therefore only cross in the litoral or abyssal; we may exclude the abyssal, and have to consider the first Decapoda as nectonic litoral forms.

By far the greatest number of the Decapoda *is litoral;* a great number, however, lives also in the *abyssal*, and partially quite distinct systematic groups have their main distribution in this region. The most important families which are exclusively abyssal are: the Acanthephyridæ and Nematocarcinidæ, the Glyphocrangonidæ, Ergonidæ and Thaumastochelidæ. All these as compared with their nearest relatives are more primitive groups, which must have immigrated into the abyssal, already in remote ages undergoing thereby but slight modification. On the other hand, the abyssal received more forms in later times. These are groups, the nearest relatives of which, often belonging to the same genus, are still found in the litoral. It is interesting to note that some of the latter, for instance the Crangonidæ and Lithodidæ, perhaps also the Pandalidæ, point quite definitely to the polar litoral. The opinion that the abyssal is especially characterized by primitive forms is not correct; both the litoral and fluvial possess primitive forms.

The only Decapods which have been adapted to the *Pelagial* as true planctonic Crustaceans, are the *Sergestidæ*, which represent a highly developed branch of the nectonic-litoral Penaids; they seem therefore to be of comparatively great age. The other forms of the high sea, the inhabitants of the Sargassum are quite isolated and belong to members of quite different groups. Forms like Varuna and the Plagusiinæ can hardly be considered pelagic; since they often live on the coasts, and are perhaps driven out on swimming objects more frequently to the open sea, as a result of their mode of life.

The most important *fluviatile* Decapods are the Atyidæ, the group Palæmon and Bithynis among the Palæmonidæ, the Potamobiidæ and Parastacidæ; the Aegleidæ (represented by a single form), the Thelphusidæ and Sesarminæ. The two last are partially adapted to subterranean life. These groups are of very different age, and their immigration into the fresh water has taken place at very different times; hence the geographical distribution of each of these groups must be studied separately.

True continental forms, perhaps sometimes still frequenting the sea, are the Cœnobitidæ and Gecarcinidæ; both are morphologically recent and specialized groups.

The Decapods of the litoral and abyssal inhabit all the different facies of these zones.

On the succeeding pages the characteristic forms of the Decapods are given for the different regions.

The last chapter gives a short review of our present knowledge of the geographical distribution of the other groups of animals.

A map shows the distribution of the regions and subregions of the marine life zones, the litoral, abyssal and pelagial. G. BAUR.

Introduction to the Study of Fungi. By M. C. COOKE, LL. D., author of 'Hand-book of British Fungi,' Fungi, Their Nature, Uses, etc. 8vo., pp. 360. London, Adam and Charles Black. 1895.

This, the latest and, as stated in the preface, 'probably last contribution to British Mycology' from Dr. Cooke, is a work 'for the use of collectors.' It is divided into three parts; namely, organography, with eight chapters; classification, with fifteen chapters—by far the largest portion of the book—and two chapters upon distribution.

Under organography there is a chapter each upon: The mycelium, carpophore, receptacle, fructification, fertilization, dichocarpism saprophytes and parasites and constituents. The author, as a lifelong student of his subject, recognizes many of the difficulties that lie in the pathway of the collector and endeavors to help him to overcome them. His method is to begin with the more common and easily seen forms and pass to the less conspicuous. Thus with mycelium the start is made with the spawn, or artificial 'bricks' of the cultivated mushroom, and he afterward considers the filaments of mildews and then the more complex forms as illustrated by the ergot grains and other indurated forms. The work is fairly well illustrated, there being in the neighborhood of one hundred small wood cuts taken in large part from the author's 'Hand-book.' From one who has written so largely upon the topics considered in the book before us there is perhaps no occasion for new engravings, but there is, nevertheless, a lack of freshness that the mycologist notes upon first taking up this work.

The carpophore, defined in brief as 'the fruit-bearer,' logically and in reality follows from the mycelium, and in the chapter upon it, it is shown in various stages of complexity from the comparatively simple bearing of spores upon the free tips of threads to the globose compact structure, where the spores are produced in sacs within the closely knit tissue. The author does not hesitate to use the names of genera without stint in citing instances, and these names, being set in italics, give the pages a heavy cast of countenance that might not please the beginner upon the first acquaintance. In fact it is to be inferred that Dr. Cooke expects more of his latest work than a mere introduction. Some of his earlier books may well serve as a preparation for this. A case, and not an extreme one, is the following upon page 262: "In *Chætophoma* the penthecia resemble those of *Phoma;* but are innate in a dermatioid subiculum resembling *Fumago* or *Asterina.*" Here we have the free use of genera, but it is innate, dermatioid and subiculum that the beginner might stumble over. He will naturally turn to the glossary to find none of these words mentioned and be disappointed. Upon the other hand, he may notice in the brief glossary the following: 'Cryptogamia—applied to the lower orders of plants in which there are no conspicuous flowers as there are in Phanerogamia.' To say the least, the mind of the reviewer is left in the dark concerning inconspicuous flowers.

The chapter upon fructification precedes that on fertilization, which does not seem entirely logical; but it is to be remembered that the author holds that sexual reproduction is not well established, or, in his own words, "the instances in which sexual reproduction has been determined are exceptionally few." This subject of fertilization is treated somewhat at length with several engravings, and it is a surprise to have it finally dismissed with the remark that "experience and investigation of forty years have shown that lichens and fungi still remain practical exceptions to the rule of sexuality."

The above view naturally leads one to look at the bibliography under each subject, and it is found far from complete. For the rusts (Uredineæ) the only American authority cited is Dr. Farlow. Under the circumstances it is a pleasure to find that Ellis and Everhart receive mention under the bibliography of the Pyronomycites, Morgan under puff-ball fungi, and there the matter ends, save under the head of bibliography for geographical distribution, where the list of nine, not all American, begins with Schweinitz and includes Berkeley, Curtis, Ellis and Peck. It is noted that Dr. Burrell is credited with first discovering a plant disease of bacterial origin; namely, 'the shrivelling o pears' in 1880 due to *Micrococcus amylovorus*.

The total number of described species of fungi is given as 40,000, an estimate founded upon the Sylloge of Dr. Saccardo.

Under the chapter upon geographical distribution it is stated that the fungi are not yet well enough known to more than conjecture as to their distribution on the earth. China is still an unknown land and India but little better, and Africa is a 'dark continent' so far as fungi are concerned. The fleshy fungi are mostly in the temperate regions. Nearly the whole of the Amaniteæ groups of exceedingly poisonous toadstools are rarely met with in the tropics.

Under classification some of the salient points are introduced, as naked and covered spores, perfect and imperfect forms and the character of the spore covering. While not accepting the classification offered by Brefeld in full, Dr. Cooke recognizes its influence and summarizes it in tabulated form. In the same chapter a page and a half is given to the drawing of lines of contrast between lichens and fungi, and the first page of the introductory chapter states, "It is now known that aquatic fungi are not an impossibility, that algæ may grow in damp atmosphere and that some portions of the substance of lichens may be derived from their matrix." From these statements the student would gain no encouragement to incline toward the modern theory of the fungo-algal conception of lichens.

The book is printed upon unusually heavy paper with uncut edges and weighs about three pounds. Half the size and bulk would make it many times more companionable.

While the faults have been most largely pointed out, the book cannot but be useful and aid the collector to reach the conclusion expressed in the last sentence of the work: "The whole history of one species worked out with perseverance and intelligence will present the key to a knowledge of many kindred species and always prove to be a valuable contribution to science when the names of species are changed or forgotten." When this fact is realized in the collector he becomes a working factor in the strict sense for the advancement of his science. BYRON D. HALSTED.

A Preliminary Report on the Geology of South Dakota. By J. E. TODD. South Dakota Geological Survey. Bulletin No. I. Sioux Falls, South Dakota. 1895. Pp. viii, 172. Plates V., figures 2, and preliminary geologic map of South Dakota.

In the above report Prof. Todd, who is the State Geologist, has summarized what is known of the geology of South Dakota. The author's studies of the geology of this State began in 1881, since which time his connection with the United States and State Surveys has enabled him to examine in the field most of the geological formations found in South Dakota. The work is written in popular form in order that it may serve as a geological guide to the citizens of the State; but in its pages is also found matter of value to the teacher and geologist.

The report contains a chapter devoted to each of the following topics: Introduction, topographic features, sketch of the geology of the State, eruptive rocks, geological history of South Dakota, and economic geology, while the description of the geological formations of the State occupies four chapters, making ten in all. Prof. Todd finds that the following systems are represented: Huronian, Cambrian, Lower Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, Tertiary and Quaternary, while 25 feet of shales in the vicinity of Deadwood is referred doubtfully to the Devonian. On consulting the geologic map it will be seen that about two-thirds of the State is covered by formations belonging to the Cretaceous system, of which the Colorado group is first in area and the Laramie second. After the Cretaceous system the Miocene of the Tertiary is second in areal extent, and the Huronian third.

Among minerals of economic value, gold is the most important, the Black Hills in 1893 producing $4,000,000. The author says that the oxide of tin (cassiterite) 'occurs very generally in the granite rocks about Harney Peak,' but there is no statement in reference to the production of the mines in this region, the development of which has been a subject of general interest. The best building stones of the State are the red Sioux quartzite of the Archæan, while in the Black Hills is the gray or reddish Dakota sandstone of the Cretaceous, which is said to compare very favorably with the well known Berea stone of northern Ohio.

The State Geologist expresses the hope that this Bulletin 'may be but the first of a long series' that will be published by the State, and the geologists of the country heartily echo this wish. It remains for the prosperous agricultural States of the 'Great Plains' to remove the stigma resting upon them in having neglected for so many years the study of their natural history and geology. It is not true, as has been popularly supposed, that they are comparatively barren in mineral resources, and, furthermore, there are problems of the greatest scientific interest awaiting investigation. The failure by the Dakotas, Nebraska and Kansas to provide for adequate geological surveys is in marked contrast to the liberal support which such surveys have received from the tier of States to the east—Minnesota, Iowa, Missouri and Arkansas—surveys which have accurately described the geology of those States and made known their natural resources, the development of which has added greatly to their wealth.

C. S. PROSSER.

Die Chemie der Zuckerarten. By DR. EDMUND O. VON LIPPMANN. Braunschweig, Vieweg und Sohn. 1895. Pp. xxvi+1176.

In 1879 von Lippmann published in the *Zeitschrift des Vereins für die Rübenzucker-Industrie des Deutchen Reichs*, a memoir entitled 'Monographie der Zuckerarten.' This valuable compilation was practically a summary of all that was known at that time about the more important carbo-hydrates; it filled about seventy quarto-pages of the journal in which it appeared.

Three years later the author followed the treatise named with a book, 'Die Zuckerarten und ihre Derivate.' This was based on his former publication and aimed to present all known facts regarding the physical and chemical properties of the different sugars.

The unexpected and certainly unprecedented growth which sugar chemistry experienced within the decade following the issue of this work, made a new, up-to-date, issue of the same greatly needed and desired. Numerous requests to undertake this task were addressed to its author and these wishes were finally responded to by the publication of the work forming the subject of this notice.

Die Chemie der Zuckerarten has its subject-matter divided into four parts, which, in turn, are subdivided into sections.

The first three parts are given to, respectively, the mono-, the di- and the tri-saccharides. The fourth part contains discussions on: the constitution, configuration and synthesis of the sugars; the relations of optical and calorimetric constants; the origin of the sugars in plants; the physiological importance of the sugars.

The saccharides are arranged and discussed in sequence according to the number of carbon atoms they contain. Thus, of the mono-saccharides, the bioses, sugars having two atoms of carbon, are first considered; next come the trioses, the tetroses, the pentoses, etc.

The hexoses (the $C_6H_{12}O_6$ group) are divided into the aldo- and the keto-hexoses; the former exhibiting the aldehyde-structure, the latter containing the characteristic ketone-group. Dextrose (d-glykose) is a representative of the former, levulose (d-fruktose) of the last-named class.

No less than 234 pages are given to dextrose. This may indicate the thoroughness which characterizes the whole work.

The most important of the di-saccharides, is of course, sucrose (cane sugar). The author devotes 244 pages to its consideration. Lactose, maltose and iso-maltose are also given exhaustive treatment in this part of the book.

The leading representative of the tri-saccharides is raffinose. This substance, melecitose and a few other carbo-hydrates of analogous constitution receive the attention due them, and are folllowed by the learned and able disquisitions on the constitution, configuration and synthesis of the sugars, etc., previously mentioned.

Very full and complete indices of subjects and authors conclude the volume.

The time and labor expended merely in the collection of the material contained in this publication must have been enormous. Some faint conception of this may perhaps be gained on learning that no less than two thousand two hundred and twenty-two authors are referred to or quoted in its pages, exact reference to their writings being given in all cases.

The style throughout is scholarly and lucid. The treatment of the subject-matter is fair and impartial. No pains have been spared to make this work a standard one; beyond question, von Lippmann's Chemie der Zuckerarten is a classic of chemical literature.

FERDINAND G. WIECHMANN.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE March number contains three articles upon the subject of the Röntgen rays, which has excited so much interest during the past month. The first of these is by A. W. Wright. After a brief history of the subject, the author describes in some detail the experiments which have been performed at the Sloane physical laboratory in New Haven. These have yielded results similar to those described elsewhere, but with a remarkable degree of refinement. Examples are given of a picture made from an aluminum medal, in which the relief on both sides is shown, also the lettering and milling around the edge. It is stated that in the original negative it is almost possible to decipher the individual letters. The details are given of the special methods which have been found most successful in yielding good results. Some of the typical pictures obtained are given on an accompanying plate. A second plate shows the impressions given upon a sensitive surface by diverging stream lines through two parallel slits in a copper plate. Three experiments were performed: first, with both slits open simultaneously; second, with only one open at a time, so that the streams were independent; and third, with the two streams passing by a powerful magnet. The first two showed very little, if any, distinct action between the streams themselves as regards their direction. The effect of the magnet in the third case was also negative. In another experiment, however, in which a very thin gold leaf was interposed in the path of the rays, a deflection by the magnet of about half a degree was observed, due to the loading of the streams with metallic particles; the mutual repulsion of the streams was also clearly shown. In all these cases the rays were proved by measurement to leave the surface of the glass of the vacuum tube nearly normally. The article closes with a quotation from an earlier paper (1870) by the same author, upon electrical shadows from the Holtz machine, to a certain extent anticipating the results that have recently excited so much interest.

The paper by Trowbridge shows how pieces of metal can be located, for example, in the human body by cathode photography, based upon a principle analogous to that employed in the Rumford photometer. He used two Crookes' tubes with two terminals at an angle with each other, and excited by a Tesla coil. The author states that by use of the Tesla coil he has succeeded in obtaining pictures in less than a minute. The destruction of the tubes is prevented by placing them in a vessel filled with paraffine oil, while the oil is cooled by snow or ice placed outside.

The third article, by H. A. Rowland, W. R. Carmichael and L. J. Briggs, discusses briefly the sources of the rays. By using a tube of a very high degree of exhaustion it was demonstrated conclusively that the main source of the rays was a minute point on the *anode* nearest to the cathode. At times a minute point of light appeared at this point but not always. Added to this source the whole of the *anode* gave out a few rays. From the cathode no rays whatever came; neither were there any from the glass of the tube where the cathode rays struck it as described by Röntgen. "In the other tubes there seemed to be diffuse sources, probably due in part to the oscillatory discharge, but in no case did the cathode rays seem to have anything to do with the Röntgen rays."

The first article of the number is by J. B. Hatcher upon 'Recent and Fossil Tapirs.' In this he gives a detailed description of the new species *Protapirus validus*, and also of a number of allied forms. Further he gives a condensed summary of the classification and relations of recent tapirs, with an account of their phylogeny. The article is accompanied by four plates. Another geological article is by Robert Bell, summarizing the proofs of the rise in the land about Hudson Bay. These proofs are of varied character, and the cumulative evidence is so strong that there can hardly be any question as to the conclusion reached. The rise in land has been comparatively rapid, and the elevation is believed to be still going on. O. C. Marsh, in a short article upon the 'Wealden Formation of England,' shows that it is unquestionably to be referred to the Jurassic instead of the Cretaceous, as formerly believed. S. F. Peckham and Laura A. Linton have an article on 'Trinidad Pitch,' in which analyses are given of some twenty-seven specimens obtained at different points in the neighborhood of Pitch Lake, Trinidad. The article presents some important conclusions as to the composition of this material in general. G. R. Putnam describes the results of recent pendulum observations at different stations in the Southern United States, more particularly at New Orleans, Galveston, Austin and Laredo. These show a very slight excess of gravity near the Gulf coast as compared with interior stations; this excess, however, is so small as to indicate a close approach to the condition of hydrostatic equilibrium called for by the principle of isostasy. Otherwise the large accumulation of the sediment in the Gulf, brought down by the Mississippi from its drainage area, would lead one to expect a greater increase in gravity at the points named.

A brief account of a new meteorite from Forsyth county, North Carolina, is given by Dr. E. A. de Schweinitz. F. A. Gooch and A. W. Peirce describe 'a method for the separation of selenium from tellurium, based upon the the difference of the bromides.' F. P. Adams and B. J. Harrington describe some interesting minerals from the nepheline-syenite of Dungannon county, Ontario. One of these is a new variety of hornblende, having a constitution analogous to that of garnet, and peculiar optical properties. The name *Hastingsite* is suggested for it. The other is a titaniferous andradite. S. L. Penfield and J. H. Pratt describe the occurrence of the rare mineral *thaumasite.* This species has been known hitherto only from Sweden and is one of the most remarkable of minerals in composition, being a hydrous silicate-carbonate-sulphate of calcium. It contains 43 % of water and has a specific gravity of only 1.88. The analysis here given confirms those made of the Swedish mineral; the authors suggest a structural formula to explain the anomalous composition, including the fact that the water goes off at four different temperatures.

AMERICAN CHEMICAL JOURNAL, FEBRUARY.

On Halogen Addition Products of the Anilides: By H. L. WHEELER and P. T. WALDEN. The authors find that when certain salts of the anilides are treated with bromine containing hydrobromic acid, perhalides are formed which are analogous to the cæsium and ammonium perhalides.

The Action of the Halogens on the Methylamines: By IRA REMSEN and JAMES F. NORRIS. The formation of a product containing two bromine atoms, by the action of bromine on trimethylamine hydrobromide, led to the study of the action of the halogens on trimethylamine. In the product formed the bromine appears to replace the hydrogen of the hydrobromide. A similar compound containing iodine is formed, and probably one containing both bromine and iodine.

On Silicides: By G. DE CHALMOT. By the use of the electric furnace the author has obtained crystals of copper and silver silicides, which, however, always contain some calcium as an impurity.

Some of the Properties of Liquid Hydriodic Acid: By R. S. NORRIS and F. G. COTTRELL. The authors have prepared pure hydriodic acid by condensing the dry gas in tubes cooled by solid carbon dioxide, and have studied the action of this acid on many metals, oxides, gases and non-metallic elements. This acid does not act on carbonates and in general is less active than the solution of the gas in water.

On the Preparation of Hydrobromic and Hy-

driodic Acids: By J. H. Kastle and J. H. Bullock. The use of naphthalene and bromine is recommended for making hydrobromic acid, and a mixture of resin, iodine and sand for hydriodic acid.

Turmerol: By C. Loring Jackson and W. H. Warren. Turmerol, prepared from the crude product by distilling *in vacuo*, when treated with nitric acids yields paratoluic acid. It is considered to be an alcohol containing a benzene ring with methyl and carbon side chains in the para position.

Bromine deviratives of Resorcine: By C. Loring Jackson and F. L. Dunlap. It is not possible to replace two of the bromine atoms in $C_6HBr_3(OC_2H_5)_2$ by hydrogen, unless the hydrogen atom is first replaced by the nitro group. The introduction of a hydroxyl group also facilitates the replacement of the bromine. The ethoxy groups do not weaken the affinity of the bromine as the free tribromresorcine is easily decomposed.

Trinitrophenylmalonic ester: By C. Loring Jackson and C. A. Soch. The method of preparation, reactions and derivatives of picrylmalonic ester, which Dittrich was unable to obtain, are given in this paper.

The artificial production of Asphalt from Petroleum: By C. F. Mabery and J. H. Dyerley. After removing the oils used for illuminating purposes, the residue is distilled slowly while air is drawn through. Products of different specific gravity are separated and used for various purposes in which asphalt has been used.

On the Action of Phosphorus Pentachloride on Parasulphaminebenzoic Acid: By Ira Remsen, R. N. Hartman and A. M. Muchenfuss. The product formed by the action of phosphorus pentachloride on parasulphaminebenzoic acid, when heated, decomposes in two stages, and the final product contains the nitrogen group in combination with the carbon atom instead of with the sulphone group as at first. Some light is thrown on the nature of this change by these investigations.

This number also contains a review of the work on *Chemical Technology* by Groves and Thorp. Vol. II.

J. Elliott Gilpin.

PSYCHE, MARCH.

The number is mostly occupied by the Presidential address of Clarence M. Weed on the 'Hibernation of Aphides,' summarizing previous knowledge. J. W. Folsom gives an account of the oviposition of *Thanaos juvenalis*, and a supplement is occupied by descriptions of insects, mostly New Mexican, by T. D. A. Cockerell and C. F. Baker.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

At the meeting of the Geological Section of the New York Academy of Sciences, held on February 17, 1896, the following papers were presented:

The first paper was read by Mr. L. McI. Luqueer, entitled 'Notes on Recent Accessions of Interesting Minerals,' with exhibition of specimens. Mr. Luqueer described in detail the minerals that he had recently discovered at the feldspar quarries in the northeastern part of Westchester county. They include uraninite, autunite, uranophane, washingtonite and the common minerals of pegmatite veins. He showed that the veins occurred in close association with an area of augen-gneiss, regarded as intrustive and now being studied by himself and Mr. Heinrich Ries.

The second paper was by J. F. Kemp, entitled 'The Cripple Creek Gold Mining District of Colorado.' The paper was illustrated by about thirty lantern views, most of which were taken by the speaker during the past summer, and by an extensive series of rocks and ores. After a brief historical review the region was described in detail, without, however, introducing anything essential that is not already contained in the Cripple Creek atlas folio of the United States Geological Survey, which was prepared by Messrs. Cross and Penrose.

J. F. Kemp,
Secretary.

THE TORREY BOTANICAL CLUB.

The regular meeting of the Torrey Botanical Club was held on Tuesday evening, February 11th. Two new members were elected. Mr. A. A. Heller contributed an interesting paper entitled 'Botanizing in Hawaii.' Lantern views were presented illustrating the geography and topography of the islands and a number of the more interesting plants. About twenty-five per cent. of the species collected are supposed to be undescribed. The endemic character of the flora of the islands, and of each island as contrasted with the others, was dwelt upon.

Dr. Arthur Hollick, through Dr. Britton, submitted a paper on 'New Leguminous Pods from the Yellow Gravel Sandstone at Bridgeton, N. J.' The paper was illustrated by specimens belonging to the genera *Lonchocarpus* and *Mezoneurum*.

H. H. RUSBY,
Recording Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held February 5th; forty-four persons present. Mr. Herbert Lyon Jones spoke of the biological adaptations of desert plants to their surroundings, mentioning first the food of plants, their adaptations for retaining moisture, and the adaptations that go to preserve the moisture. The struggle of plants in tropical regions was noted; also the struggle of desert plants against inorganic nature. The effects of the amount of rain, the variations in leaf surface, and the protections afforded to leaf and to stem were discussed. Where the rainfall is limited to a few inches the leaves are thickened and covered with a coating of wax; in some regions of considerable rainfall the plants suddenly put out delicate leaves. The Australian Acacias show the most numerous adaptations of leaf surface; in some Cacti the leaf surface is entirely wanting, the function being performed by the stems.

The protection afforded to leaf and stem by coatings of wax is always thick in desert plants, and the hairy coatings form a striking adaptation in many plants, and are best shown in the plants of the Mediterranean flora.

The fertilization of desert plants was described in detail, also the distribution of their seeds and fruits; and Mr. Jones closed with remarks explanatory of the fine series of lantern slides illustrating the biological adaptations of desert plants to their surroundings.

SAMUEL HENSHAW,
Secretary.

ACADEMY OF NATURAL SCIENCES, PHILADELPHIA, FEBRUARY 18.

A PAPER entitled as follows was presented for publication: 'Contributions to the Life History of Plants, No. XII.,' by Thomas Meehan: 1. Fecundity of Heliophytum Indicum; 2. Origin of the Forms of Flowers; 3. Spines in the Citrus Family; 4. Flowers and Flowering of Lamium purpureum; 5. Cleistogamy in Umbelliferæ; 6. Rhythmic Growth in Plants; 7. Pellucid dots in some species of Hypericum; 8. Honey Glands of Flowers; 9. Varying Phyllotaxis in the Elm; 10. Special Features in a Study of Cornus stolonifera; 11. Folial Origin of Cauline Structures; 12. Polarity in the leaves of the Compass and other plants; 13. Hybrids in Nature; 14. Origin and Nature of Plant Glands; 15. Nutrition as affecting the Forms of Plants and their Floral Organs; 16. Some Neglected Studies.

Mr. D. S. Holman exhibited a new stage for the microscope devised for the purpose of studying large objects and widely spread preparations. It can be adapted to all instruments provided with square stages and has a motion of two inches each way.

Preparations of minerals containing diatoms in transverse section and other microscopic arrangements of diatoms prepared by Mr. John A. Schulze were exhibited by Mr. F. J. Keeley.

Prof. Edw. D. Cope described specimens of fossil reptilia from the Premian and Trias. They belonged to the order Cotylosauria which had been described by him in 1879, and was afterwards characterized by Seeley from African types. The order embraces the families Elginiidæ, Pariasauridæ, Diadectidæ and Pariotichidæ, the distribution and characters of which were dwelt on. New genera of Diadectidæ were described under the names Bolbodon and Diatomodon, the teeth of which, as well as of the other genera of the family, were illustrated. The Platodontia may have been derived from the Diadectidæ. The roof over the temporal fossa and the foramen for the temporal eye were illustrated by specimens. The molar teeth of a species of Empedias, the cranium of Bolbodon tenuitectis and the lower jaw of Diatomodon were exhibited. Another form described under the name Conodectes favosus may belong to the Diadectidæ, but its relationships are at present uncertain.

EDW. J. NOLAN,
Recording Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the forty-third meeting of this Society, held at Washington, D. C., February 12, 1896, President S. F. Emmons in the chair, communications were presented as follows :

Structure of the Elk Garden Coal-Fields : By MR. J. A. TAFF. The Elk Garden coal-field comprises about one-third of the area of the Piedmont sheet (of Geol. Atlas of United States, U. S. G. S.), and extends about S. 30 W. across its center. This coal-field is limited on the east by the Allegheny front and on the west by the Backbone Mountain. The south branch of the Potomac drains the field from the Grant county line northward, while the southern part is in the basins of Red Creek and Blackwater River.

In topography as well as in structure the Allegheny front marks the dividing line between the middle or Great Valley and the western or plateau divisions of the Appalachian province. The valley country presents almost level crested mountain ridges, with smooth valleys between and the Allegheny front faces it with an escarpment 1100 to 2000 feet high. The Elk Garden coal-field here represents a part of the plateau region. It is not a smooth plain, but in its nearly flat surface points may be seen in the ridges which extend from the Allegheny front and Backbone Mountain into the Potomac Gorge. The structure of the valley region is illustrated by the topographic types, *i. e.*, sharp anticlinal folds in the mountain ridges and obtuse, wide and undulating folds in the valleys.

In the Elk Garden coal-field the topography is more diversified. Both the anticlinal and synclinal folds are occupied by valleys and the mountains are upon their borders. From the crests of Allegheny front and Backbone Mountain the dips of the conglomerate are 18° to 25°, but soon decrease and approach the Potomac valley almost horizontally, forming thus an obtuse synclinal basin. This basin rises toward the southwest and divides near the center of the field, one division following Stony River and Red Creek valleys, while the other extends with the Potomac and passes southwest beyond Fairfax Knob. This division of the main synclinal basin is due to a high anticlinal fold which pitches downward between Canaan and and Brown Mountains and is lost in undulations near the center of the field.

The structure of the Elk Garden coal-field presents the rocks most advantageously for the coal operator. The North Potomac river has severed the five productive coal seams ranging in thickness from four to fourteen feet, so that they incline downwards toward its gorge and and also allow easy access for rail transportation.

The paper was illustrated by topographic and relief maps and by structure sections.

Disintegration and Decomposition of Diabase at Medford, Mass. By GEO. P. MERRILL.

Mr. Merrill described in considerable detail the chemical and physical changes which had taken place in the breaking down of the diabase at Medford, giving analyses of the fresh and decomposed rock as well as of the portions removed by solvents. The most interesting results brought out were: That the firm rock yielded up nearly 36% of its constituents to the solvent action of hydrochloric acid and sodium carbonate solutions, as against 32.3% by the residual sand; further, that in the process of degeneration some 20% of material was lost, the various constituents being removed in the following order, that which suffered most heavily being mentioned first: K_2O; CaO; MgO; Fe_2O_3; SiO_2; Na_2O; P_2O_5; the alumina, which served as the basis for calculation, being for the time assumed to have remained constant.

The degeneration was regarded as being mainly postglacial, and as due wholly to atmospheric agencies. Remarks were made as to the relative rapidity of degeneration in high and low latitudes, Mr. Merrill taking the ground that the apparent greater rapidity of decay in warm latitudes and in forested areas, was due to protection from erosion whereby the disintegrated material was allowed to accumulate. He, however, believed that there was a difference in kind in the degeneration in high and low latitudes, in the former mechanical agencies prevailing, and in the latter chemical.

Notes on the Geology of the San Carlos Coal Field, Trans-Pecos, Texas. By T. WAYLAND VAUGHAN.

The author gave the results of a reconnoissance made jointly with Mr. T. W. Stanton, of the U. S. Geological Survey, during the field season of 1895. The coal field is situated in the Veija Mountains. Some general observations on the structure and topographic features of the region were made. Two detailed sections of the mountains were described. The general features of the combined sections, beginning at the top, are:

3. A massive lava-flow of quartz-pantellerite, which forms the summit of the mountains and from 400–600 feet thick.

2. A series of interbedded massive and fragmental rhyolites and conglomerates, sandstones and clays, into which a sheet of basalt has been intruded. South of Chispa this series is about fifteen hundred feet thick, but it is not so thick at San Carlos, where there is not such a variety of volcanic products.

1. Alternating beds of sands and clays—at San Carlos about fifteen hundred feet thick—and in which the coal occurs. Vertebrate fossils of Cretaceous age were found in the sandstones and clays above the coal. Below the coal a rich invertebrate fauna was collected, whose age was determined by Mr. Stanton to be Pierre (in the terminology of the Western Interior Region) or Taylor (in the terminology of the Texas Region). The age of the coal was determined to be Pierre or Taylor, as Mr. E. T. Dumble had previously shown. About seven miles southwest of Chispa a fault was described by which the Benton shales had been carried down below limestone belonging to the Fredericksburg division (of the Lower Cretaceous). The Benton shales are thinly laminated, bluish, calcareous shales, and contain *Inoceramus labiatus*, a fossil characteristic of the Benton. These shales are underlaid by a hard blue limestone, containing *Alectyonia carinata*, which is characteristic of the Washita division. The Dakota sandstone is absent. Limestone belonging to a lower horizon of the Washita division was found, beneath which was a limestone containing a fauna characteristic of the Fredericksburg division.

Dr. E. C. E. Lord followed Mr. Vaughan's paper on the general geologic features of the region with a petrographic description of the rocks collected. The rock types were:

1. Massive rhyolite.

1*a*. Rhyolite breccias.

2. Quartz-pantellerite, which was described from America for the first time.

3. Basalt. WM. F. MORSELL.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, FEBRUARY 11, 1896.

On the Geological Work of Vortices and Eddies, by T. A. JAGGAR, JR.

A vortex occurs wherever a fluid current is retarded or deflected. The properties of such movements have been worked out mathematically by Helmholtz and others; the present writer's aim is to express in simple terms the application of their results to geology, and to demonstrate it experimentally. Mention was made of the importance of vortical movement in the study of meteorology, the flight of birds, oceanic currents, dune formation, snow drift and nevé sculpture; and a series of experiments was exhibited with specially devised projection apparatus. A horizontal beam of light projected to the screen through narrow glass tanks served to show Bjerknaes' beautiful experiment with vortex rings, the actual development of rippledrift on a sandy surface in cross-section, the growth of ripplemark and some imitative beach marks. Apparatus for bending the beam upward through glass-bottomed trays showed the gradual separation of the linear sand ridges under the influence of the ripple-forming vortices in both rippledrift and ripplemark, and attention was called to the possibility of experimentally illustrating the action of coastal eddies in building cusps.

To be published in the proceedings of the Boston Society of Natural History.

T. A. JAGGAR, JR,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of February 17, 1896, Dr. Adolf Alt spoke of the anatomy of the eye, and by aid of the projecting microscope exhibited a series of axial sections representing the general structure of the eye in thirty-one species of animals, comprising two crustacea, the squid, three fish, two batrachians, two reptiles, ten birds and eleven animals.

Prof. F. E. Nipher gave an account of the Geissler and Crookes tubes and the radiant phenomena exhibited by each when used in connection with a high tension electrical current of rapid alternation, and detailed the recent discoveries of Prof. Röntgen, showing that certain of the rays so generated are capable of affecting the sensitized photographic plate through objects opaque to luminous rays. Attention was also called to the experiments of Herz and Lodge with discharges of very high tension alternating currents which showed that by the latter certain invisible rays are produced, which like the Röntgen rays, are capable of passing through opaque bodies, such as pitch, but differing in their refrangibility by such media.

One person was elected to active membership. WILLIAM TRELEASE,
Recording Secretary.

THE WOMAN'S ANTHROPOLOGICAL SOCIETY.

THE Woman's Anthropological Society, which under the presidency of Miss Alice C. Fletcher, has greatly enlarged its scope and membership, held its 138th meeting February 1st. After the usual business, the session was given over to Miss A. Tolman Smith, director of the section of psychology.

The paper of the day was by Miss Theodate L. Smith, of Clark University, subject 'The Motor Element in Memory.' The paper described in detail a series of laboratory experiments made by the writer with a view to determine the quantitative value of the motor element in the total act of memory.

Discussion of the subject was deferred to a subsequent meeting, and the remaining time was given to the problem of emotional expression which has occupied the attention of the section for several months. Brief letters were read from Profs. Melville Bell and David Bell, also from the directors of dramatic expression in leading universities of this country, setting forth their views as to the relation between the psychic and the physical agitations that make up the emotional state. The subject was illustrated from the standpoint of dramatic art by Mrs. J. M. D. Lander, who drew a most subtle and vivid picture of 'dual personality' in the consciousness of the actor.

Miss Wescott, principal of the Western High School, closed the discussion with a summary of tests of emotional disturbance applied by means of the Kymographion under the direction of Dr. Arthur MacDonald.

From a series of graphic records showing the effects of various emotional and mental states upon the breathing, two were selected as typical, one of the nervous, the other of the lymphatic temperament. It was interesting to note that, while in the latter the registration of emotional disturbance was relatively less than in the former case, yet there was the indisputable record of such disturbance in spite of the subject's unconsciousness of the effects. Two inferences seemed justified by the series of experiments: first, that one breathes less during any effort at concentration and under a depressing emotion; second, that one breathes more under the exhilarating influences of pleasure or amusement. Two questions were suggested as the practical outcome of the experiments: First, if the tendency of education is toward repression and self-control, is it not important to supplement courses of study by exercises that foster spontaneity; second, if the child actually breathes less under close application to study, to what degree is our physical culture work correcting this deficiency?

A. CARMAN,
Secretary.

NEW BOOKS.

James Clerk Maxwell and Modern Physics. R. T. GLAZEBROOK. New York, Macmillan & Co. 1896. Pp. vi+224. $1.25.

Vegetable Culture. ALEXANDER DEAN. London and New York, Macmillan & Co. 1896. Pp. vi+132. 35 cents.

Exercises in Physical Measurement. LOUIS W. AUSTIN, CHARLES B. THWING. Boston, Allyn & Bacon. 1896. Pp. x+198. $1.50.

The Whence and the Whither of Man. JOHN W. TYLER. New York, Charles Scribner's Sons. 1896. Pp. xv+312. $1.75.

SCIENCE

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SCIENCE

Friday, March 13, 1896.

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*A LECTURE UPON ACETYLENE.**

A year and a-half ago, if a chemist had been told that a new illuminating gas could be obtained from the evil-smelling product with which he was only too well acquainted in the laboratory, namely, the acetylene which forms whenever a Bunsen burner strikes down, he would have said that the idea was absurd. If a physicist had been told that the electric furnace was to be used to produce illuminating gas on a commercial scale he would have said it was quite impossible. But distinguished electricians were explaining that the telephone was impossible, while Graham Bell was inventing that instrument. So that scientific men will be well advised not to utter general opinions about the possibilities of the success of any new enterprise, and I shall endeavor to confine myself to the statement of certain facts and to the description of laboratory experiments, which constitute some new data which can be used to form an opinion regarding at least one side of this subject.

The chemistry of the manufacture of acetylene is very simple. Quicklime is reduced by carbon in an electric furnace to carbide of calcium, and enough carbon is taken not only to combine with the calcium to form carbide of calcium, but also to burn with the oxygen of the quicklime

* Delivered before the Society of Arts at Boston, January 23, 1896.

and to remove it as carbonic oxide. The process is represented by the equation: $CaO+3C=CaC_2+CO$. The carbide is obtained as a melted mass with crystalline structure, which when brought in contact with water is transformed to slacked lime, and to acetylene which is given off as a gas. The formula for this transformation is: $CaC_2+2H_2O=Ca(OH)_2+C_2H_2$. All the alkaline earths and alumina have been subjected to the same treatment, and it has been found that the carbides of barium, strontium and calcium have similar formulæ and give off acetylene when treated with water. The carbide of aluminum has the formula: Al_4C_3, and evolves marsh gas when treated with water. It may be added that a mixture of silica and carbon yields the carbide of silicon, SiC. The compound is formed when the two bodies meet as vapors in the intense heat of the electric furnace and combine as a sublimate of beautiful crystals, now sold under the name of Carborudum. The powdered crystals have sharp cutting edges, hard enough to scratch rubies, and consequently make an excellent polishing and grinding material.

It is to be noticed that this formation of carbides affects the elements which make up by far the larger part of the earth's crust, so that from a geological as well as a chemical point of view these newly discovered transformations are of the utmost importance.

The reduction of these oxides to carbides is only possible at the high temperature of the electric furnace, and it is very interesting to note that at three very different stages of temperature we have such different conditions presiding over the union of the elements that each temperature corresponds to a new chemistry.

The temperature of the electric furnace, which has been estimated to be from 3,500° to 4,000° Cent., may be considered as intermediate between the sun's temperature, estimated by different physicists at 5,000° to 8,000°, and the temperatures of our smelting furnaces, which range from 1,200° to 1,500°. Now, in the sun's atmosphere, spectroscopic observations tell us that the elements exist uncombined, and we can even observe great masses of free oxygen in the presence of heated hydrogen and of metals so transformed in the properties which we are accustomed to recognize that they do not combine, but rise as vapors from the hottest part of the sun, condense and fall back in metallic clouds, which we know as sun spots. Here, then, is a temperature which is too hot for chemistry, if we define chemistry as the science of the combination of bodies.

The next temperature on a descending scale that we have access to is that of the electric furnace; here a partial combination only is possible; much of the oxygen remains free; carbon only burns to the nonoxide of carbon, and the carbides and not the oxides of the alkaline earths are the stable forms of combination.

Then, at a lower temperature the bright red heat of our smelting furnaces, the same carbides formed in the electric furnace, when exposed to free oxygen or to air, burn to oxides and to carbonic acid, and at a still lower temperature these two unite to form carbonates represented by the chalk and magnesian limestone which make so large a part of the earth's crust. Nature has so adjusted her processes that a small residue of oxygen remains, which, mixed with nitrogen, constitutes the vital air of our atmosphere. The carbides of aluminum and silicon burn in a similar way with oxygen, and the stable condition at any temperature lower than a bright-red heat is that of silicates and carbonates which make the chief strata of the earth.

The oxidation of carbides, which became possible when our globe cooled down to a red heat and solidified, has perhaps been a superficial one, and the denser material below the crust may consist of carbides of the alkaline earths and carbides of the heavy metals like iron, and finally the metals themselves.

It is only within the last two years that experiments with the electric furnace have enabled us to study these new transformations at a high temperature, and have given us the means of estimating what must have been the primitive condition of the earth during long geological periods.

Berthelot, Moissan and others have pointed out that the evolution of marsh gas from volcanoes may be an indication of the existence of Plutonic remnants of carbides, dating from a period of higher temperature, and which we now know may give off gas when brought in contact with moisture.

The most important and orginal experiments made with the electric furnace have been published in the *Comptes Rendus* of the French Academy of Sciences by a young chemist, Henri Moissan, who had already distinguished himself by the discovery of fluorine. One of the first results which this new instrument gave in his hands was the artificial production of diamonds made by dissolving carbon in iron, and he then undertook a complete study of the formation of the carbides of the metals. Moissan's paper which interests us most directly was published on the 5th of March, 1894. It contains a full account of the formation of pure crystallized carbide of calcium and of its reactions with oxygen, sulphur, chlorine, etc., and a complete account of the formation of acetylene by the action of water upon the carbide, and nothing of scientific interest has since been added to the chemistry of acetylene, except some few experiments in European laboratories, notably upon its silver compounds.

French physicists have, however, made some very important measures of the thermic conditions which preside over the formation and decomposition of acetylene. They are a continuation of the admirable study of this singular gas, which was begun by Berthelot in 1859, and we shall find them of great value for explaining the properties which make acetylene useful or dangerous as an illuminant. The lecture will be confined strictly to the statement of facts which bear upon the proposed new gas industry, and no place can be given to the long-known laboratory processes for making acetylene, and to many experiments which display its general properties.

The idea of using this laboratory product upon a commercial scale originated in the United States, and the merit of it is due to Mr. T. L. Willson and Messrs. Dickerson and Suckert, who have secured patents; but it is important to insist upon the fact that they are not the discoverers of the crystalline carbide of calcium, nor of its transformation to acetylene and to hydrate of calcium. Moissan's publication of March 5, 1894, antedates their patents by many months, and describes completely the whole chemistry of the manufacture of acetylene.

No mention is made of Moissan's work in the reports published by the acetylene company in a lecture by Willson and Suckert before the Franklin Institute, and in a lecture before the London Society of Arts by Prof. Lewes. In these reports Mr. Willson is represented as having discovered the mode of formation of calcium carbide in the electric furnace by the reducing action of carbon upon refractory oxides. It is stated that the experiments were begun by Mr. Willson in 1888.

In such matters dates of discovery can only be established by publications, which in this case are to be found in the Patent Office reports. Mr. Willson took out four patents in 1889–1892 for electric smelting processes, and in several of them the use of carbon with refractory oxides is specified. The design seems to have been to make aluminum and its alloys and perhaps other metals. No mention is made in the reports of carbide of calcium nor of acetylene. Dickerson and Suckert, December 31, 1894, nine months after Moissan's publication, patented a process for evolving and condensing acetylene made from the carbide of calcium. And June 18, 1895, is the date of the first patent by T. L. Willson in which the report specifies the production of carbide of calcium.

Many statements have been published concerning commercial aspects of the new enterprise, but it will suffice to say here that it has not yet reached a stage at which the vital question of the cost to the consumer of the carbide of calcium can be fixed by the quotation of a market price. Small quantities can be purchased for experimental purposes in New York at a price of $5 per 100 lbs. But the manufacture in the United States does not exceed one ton per diem and is carried on at Spray, in North Carolina, a somewhat inaccessible place, and no complete account of the process has yet appeared in the best-known scientific periodicals. The commercial carbide, unlike that made by Moissan, probably contains compounds of calcium with the ash of coke, but no complete analysis has been published. Some of the statements made about the number of cubic feet of acetylene are obviously inaccurate because the figures 5.89 to 6.35 cu. ft. acetylene per 1lb. carbide are as high or higher than could be obtained if the carbide contained no ash and were absolutely pure.

The accurate measure of the gas given off by the carbide is not easy and requires the construction of a special apparatus. The writer has examined a number of samples of commercial carbide, and found that 70 to 92 per cent. of the theoretical quantity of acetylene could be obtained from them. It appears that the product which can be made to the best advantage is one which contains 84.6 per cent. of pure carbide, and which gives 5 cu. ft. of gas per pound; or, for a ton of carbide, 10,000 cu. ft. acetylene, two-thirds saturated with moisture, and measured at 60° Fahr. and 30 inches barometer. Summer and winter variations of temperature, together with barometric variations, would cause a difference of more than 15 per cent. in the uncorrected measure of the gas, and gas measured in a mountainous region, without correction for the low barometer, would differ far more from the standard amount.

If the acetylene industry shall succeed, the cost of the carbide will have to be adjusted to the price that the consumer may be willing to pay for gas, and it is preferable to treat the subject from this side and to show, as far as laboratory experiments with materials at hand will permit, what will be the probable value to the consumer of acetylene gas.

A very simple experiment illustrates in a beautiful way the ease with which acetylene can be made from the carbide. Direct a small stream of water on a half-pound lump of carbide, ignite the gas and show that the more water is poured on, the more flame is obtained. Various forms of generators can be used for the gas. The simplest one is a bell glass floating on water and containing a few lumps of carbide in a sieve. As soon as the bell glass descends so that the sieve touches the water, a shower of fine sediment of slaked lime can be seen to separate from the carbide and fall to the bottom of the jar, while the gas generated soon causes the bell to rise and removes the carbide from contact with the water. Thus the apparatus can be made to work automatically, generating gas only as fast as it is used; but it is not fitted for permanent use, because the moisture from the water generates gas, even when the contact has ceased, and the bell gradually rises, so that after twenty-four hours gas would escape if it were not used during the interval.

It is in every way preferable to separate the generator and the gas holder, and such arrangements can easily be made automatic.

The acetylene company has patented a tank for generating the gas under sufficient pressure to liquify itself, and proposes to distribute liquid acetylene in cylinders under a pressure of 600 to 700 pounds to the inch; of this project more is to be said later.

It is certain that a company purchasing the carbide of calcium and using an existing gas plant could generate acetylene and distribute it through mains at a very small expense, and with little skilled labor, so that when a price for the carbide had been established by contract the cost of the gas could be easily estimated; let us see what price such a company could expect to obtain from a consumer.

VALUE OF ACETYLENE AS AN ILLUMINANT.

Suppose we take the case of a competition with the gas companies of a large town. At first sight it would seem fair to say we pay for the light gas gives, and if a new gas gives ten times more light we are willing to pay ten times more, particularly if it possesses any other advantages; our gas bill will remain the same.

Here we come upon ground where the facts can be tested by experiments. I have made a large number of measures of illuminating power and find that with a new burner particularly suited to it 5 cu. ft. of acetylene per hour will give 200 candle power; 5 cu. ft. of Boston gas will give a little more than 25 candle power. The Brookline gas is a little brighter. From this point of view alone then we can pay in Boston about $8 per 1,000 cu. ft. for acetylene when we pay $1 per 1,000 cu. ft. common gas. But will the gas bills remain the same at this ratio? More light will probably be used and the householder will be led into a more extravagant consumption, and he must decide what he is willing to pay for the new luxury. We must count then with the tastes of the consumer, and these can only be translated into money values after long trial of the new light in many houses.

Besides the question of meeting the desire of the consumer for more or less light is another, which must be taken into consideration depending upon his expertness in burning gas and the care he is willing to take in getting economical results.

No. 1. A Sugg-table fishtail burner is shown, burning just 5 cu. ft. per hour and giving the light of 25 candles. If more or less than 5 cu. ft. of gas is passed through it per hour it gives a lower efficiency and the light costs more. The law in Massachusetts, 1882, requires that the candle power should be tested with the most efficient burners, and I have used the best one for water gas. Coal gas would have given more candle power in an Argand burner. Burning gas economically is an art which is only understood by experts, and here again the habits of consumers disturb calculations; they are not usually willing to take the pains to get the best burners, as the following experiment will show.

No. 2 is a gas burner taken off the pipes in the Technology building and represents the average condition of burners in dwellings. About one-half the illuminating power of the gas is lost in this burner, and few people think of having the burners changed when they become inefficient.

If I put a globe over the burner, about half the light is absorbed, so that with a bad burner and with a milk-glass globe we pay about four times as much as need be for light; but the use of a globe is often necessary for comfort. The acetylene gas gives a different colored light, and I thought it might pass through the globe in larger proportion, but on measuring the candle power I found this was not the case. Perhaps a globe can be found that will especially suit acetylene light.

An important question then is to be answered before we can compare the lighting power of gas and acetylene. Is an acetylene light more tolerant of lack of care in the burners and of variations in the pressure than is the case with common gas? The most superficial observation shows that the two gases must be burnt in a very different way.

Gas burnt in an acetylene jet gives less than one-tenth of its true lighting power, and acetylene burnt in a common gas burner gives a yellow, smoky flame, and when turned down to a small flame it deposits soot on the jet, clogging the burner, if the opening consists of a straight slit. Even the very fine fishtail burners with a straight slit intended for oil gas suffer from this defect when the acetylene flame is turned down.

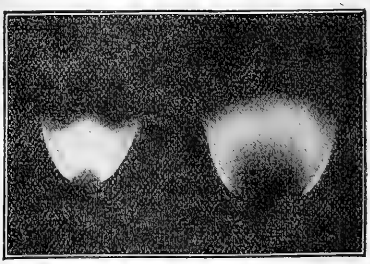
It appears then from the last experiments that the choice of burner and the mode of using it are very important factors in determining the value of any kind of illuminant, and hundreds of pages have been published on this subject with reference to oil and gas light, and it may be added that the results are not yet concordant.

Acetylene can not well be burnt in an Argand burner nor with the devices that succeed with petroleum lamps. A fishtail flame with a good exposure to the air must be used, and the best form of burner is that which throws the swiftest stream of acetylene into the air in the form of a very thin sheet.

A lava-tip burner has long been used for gas in which the opening is not a slit, but two small holes. The construction of these burners can be well shown by passing gas through two blowpipe jets, and when the two long jets of flame are made to impinge on each other at nearly a right angle they spread out into a fishtail form. Acetylene can be burnt in very small lava tip jets of this class, and gives about 30-candle power, but the light can not be turned low without losing its efficiency and smoking.

An experiment can easily be made which shows how large a quantity of air is required to render acetylene flames smokeless. Mix acetylene gas with measured quantities of air up to $1\frac{1}{2}$ volumes of air and burn the mixtures in a slit fishtail burner. It will be found that the acetylene does not diminish notably in illuminating power. Larger proportions of air begin to destroy the brilliancy of the flame. The same trials with common gas show that a very small proportion of air renders the flame less luminous. Suitable burners must be chosen in each case.

Acetylene can even be burnt mixed with one-third its volume of oxygen, giving a very brilliant flame. These experiments are only of practical value in indicating the kind of burner which should be chosen for acetylene. Another quality of the flame is very instructive from the same point of view. The acetylene flame clings to the burner in an extraordinary way, so that it is difficult to blow it out, and the luminous part of the fishtail flame almost touches the jet, while in a gas flame a large blue zone separates the luminous part from the jet. An instantaneous photograph shows well the character of the two flames and also their comparative actinic powers.*



By exploring the flame with a bit of platinum wire, it is easy to see, by the in-

*In the reproduction the gas flame appears relatively too bright.—ED.

tensity with which it glows, which is the hottest part, and also to recognize that the luminous part deposits soot on any cold object.

These experiments led to the idea of constructing a new form of burner for acetylene gas, in which the jets should be very fine and very perfect in form, and which should give the best possible access of air, and which should bring a very small section of metal in contact with the flame in order to avoid smoke and the deposit of soot.

The form eventually chosen is shown by the sketch. The burner is made of brass with nickel or steel tips. The extreme points in contact with the flame may be tipped with platinum or silver, but steel answers the purpose quite well. The most essential feature is that the tips should not be larger than $\frac{1}{16}$ inch in diameter. These burners abstract very little heat from the flame and consequently give more light than the usual form for the same candle power. They do not smoke with any height of flame. They burn acetylene advantageously with the 10- to 20-candle-power light to which we are accustomed. Lava tips are not well suited to such small flames, because the section in contact with the flame is about 20 times larger and abstracts so much heat that the metal setting for several inches in length becomes very hot. Loss of heat occasions loss of light.

It is particularly important in burning acetylene that a large supply of air should be drawn into the flame by the suction of the gas jets which issue from the two orifices of the burner. The steel jets described above provide for this by their perfection of form, as they are bored from their base and have the same proportions, which have been found to throw the swiftest stream under a given pressure with a hose nozzle.

It seems probable, in view of the careless use of burners in the ordinary consumption of gas, that one quality of acetylene will tell in its favor. With a suitable burner acetylene will tolerate greater variations of pressure than common gas. This point was determined by more than 100 measures of the candle power taken with the two gases burning under different pressures.

The smallness of the acetylene flame required to give off a brilliant light is a point in its favor, allowing the use of a great variety of globes and shades for tempering or reflecting the light.

The same quality will be found of advantage whan a strong light is to be concentrated as nearly as possible at the focus of a mirror or of a lens, as in locomotive headlights or in lanterns for projections.

It was hoped that the quantity of light given off by duplex or triplex acetylene flames would show a particularly economical consumption, but the results of measures of the candle power of such flames with or without chimneys were disappointing. It appears that defect of air supply with such flames more than counterbalances the effect of the heat which one flame communicates to the other.

It might be desirable to use the existing gas plants and to deliver, as heretofore, a gas of 20-candle power suitable for heating or lighting. Such a project seemed very easy of fulfilment, since it was at first supposed that acetylene could be used to enrich common gas, and in that case no changes would be required in the mode of distribution nor in the form of burners. Experiments have shown that it can be employed to enrich coal gas, but that water gas, which is so largely used in this country, cannot be enriched by acetylene. Water gas has little illuminating power and requires to be enriched by passing petroleum oil into the retorts during the manufacture, and it is only when water gas has already been brought up to a certain candle power that acetylene gas can be mixed with it without losing its effectiveness as an illuminant; so that it cannot be used as a substitute for petroleum to enrich crude water gas.

There is no apparent reason *a priori* why an admixture of a combustible gas should deprive acetylene of its illuminating power, and it is interesting to examine separately the effect of each one of the constituents of water gas to see which one has this property.

Brookline gas, besides 16% of illuminants derived from oil, contains equal quantities (about 26%) of hydrogen, marsh gas and carbonic oxide. If each one of these is burnt separately with acetylene it appears immediately that it is the carbonic oxide which renders the acetylene flame non-luminous. Ammonia also has a singular effect upon common gas and upon acetylene, nearly destroying the lighting power and giving a beautiful faint purple flame with curious marked fringes, but ordinarily only traces of ammonia are contained in gas. Nitrogen has much less effect than ammonia or carbonic oxide in destroying the illuminating power of acetylene.

The preceding statements tend to show that a summary of the qualities of acetylene gas, as compared with common gas, must comprise other data beside the measures of candle power, and I have endeavored to point out some of the peculiar properties of the new light which are advantageous. The price and the taste of the consumers must decide the question of competition.

The gas of small towns is usually poorer in quality and higher in price than in large towns, and perhaps the opportunities for the introduction of acetylene are greatest in this direction. Consumers may be willing to pay $15 per thousand for acetylene gas where they pay $1.50 for 16-candle water gas or coal gas.

I should expect to see it first introduced to replace the very expensive oil gas used in railroad carriages, and also for special purposes where great brilliancy and concentration are required, like the head lights of locomotives. For such purposes the Welsbach light cannot be used, because it is destroyed by jarring. The adherence of the flame to the burner is an advantage for railroad use, making the flame hard to blow out. For shop-window illumination the Welsbach light, which is very much cheaper than gas burnt in any other way, seems to be beyond the reach of competition; and the Auer burner, which is similar, is now used for street lighting in Paris, and these incandescent lights work well wherever the light is not shaken, and where the disagreeable green tint is not an objection.

For country houses acetylene light seems well fitted and might replace the very bad illumination of gasolene light.

Much skill and special knowledge are required to run gas works, while the making of acetylene from the carbide or its distribution as a liquid is so simple that acetylene stations could be established in many villages too small to make gas works pay. Moreover the winter consumption of gas is two or three times that of the summer, when the gas plant lies idle in part. With acetylene there is an advantage in this direction, because the value of the plant would be much less.

The whiteness of acetylene light renders it useful for displaying or sorting colors, and some experiments made with Mr. C. R. Walker show that, for photographic purposes, when equal quantities of acetylene light and of water-gas light, measured by candle power, are compared, the acetylene light has two and one-half times the actinic value of the other.

POISONOUS QUALITIES OF GAS AND ACETYLENE.

Continuing the comparison of common gas and acetylene, let us see how the case stands from a sanitary point of view. We see reports in the newspapers of deaths and attacks of illness from gas poisoning, the dropping out during the night of the core of a gas cock or a break in a pipe, would often be an accident fatal for the inmate of a small, close bed chamber. Recently persons have been poisoned by a defect in the gas main outside of their houses. Workmen are frequently made ill by a leak in the gas mains while working in a trench, but the officers of the gas companies state that such accidents are very seldom fatal.

There is no question then about the poisonous qualities of common gas and particularly of water gas. Is the new illuminant likely to be less dangerous?

The poisonous constituent of common gas is carbonic oxide. London gas contains 3.2 to 7%; Paris gas 7%; Berlin gas 8%; Boston gas 26%.

Formerly there was a legal limit of 10%, which is now removed, and the introduction of water gas has raised the percentage to this very high and dangerous amount.

Carbonic oxide is not irritating or corrosive, and it seems strange that a compound so nearly allied to carbonic acid, which is innocuous, should act as a rapid poison.

The mode of action is this: Carbonic oxide is absorbed and retained by the blood in a way quite different from other gases. It combines with the red corpuscles, and the compound shows under the spectroscope special absorption bands, which make the recognition of its presence easy.

Blood which has taken up a certain quantity of carbonic oxide no longer is capable of taking up oxygen in the lungs and conveying it through the circulation, and death by suffocation ensues, just as if there were not enough oxygen to breathe.

The blood is so sensitive to carbonic oxide that so little as 0.03 % in the air can be shown (Bull. Soc. chem. (6) 663) when a solution of blood is brought thoroughly in contact with a mixture containing carbonic oxide.

The best way to bring a liquid in contact with a large body of air or gas would be to have it circulate by means of minute canals, using a pump to keep the current in motion through the cell walls of a sponge, while the air was continually changed by squeezing and relaxing the sponge. We can find such a little machine in a very perfect form in the body of a small animal, the veins and arteries constituting the canals, the pump being represented by the heart, and the sponge by the lungs.

If we sacrifice a mouse as a martyr to science and enclose him in a tight box containing air with a known percentage of carbonic oxide, and kill him after 3 or 4 hours, we can detect the carbonic oxide absorbed by his blood.

A similar method is best suited to discovering whether acetylene is absorbed by the blood. We might suspect that this would be the case since the two gases have in common the peculiar property of being absorbable by solutions of subchloride of copper.

Grehant (Comptes Rendus 1895, II., 565) made a careful comparison of carbonic oxide and acetylene in respect to their poisonous qualities upon dogs. He took care to have 20% oxygen always in his mixtures, so as to give it the vital quality of air and not to kill his animals by suffocation. He added 1% carbonic oxide (*i. e.*, enough Paris gas (containing 7% CO) to give 1% carbonic oxide). After 3 minutes the animal suffered; after 10 minutes the dog was very sick and his blood contained 27 volumes per 100 of carbonic oxide. The dog would have soon died if the experiment had been prolonged.

In a mixture containing 20% oxygen and

20% acetylene a dog breathed without inconvenience for 35 minutes. His blood contained 10% acetylene, less than $\frac{1}{50}$ the rate of absorption of carbonic oxide and not a larger percentage of acetylene than would have been absorbed by water. The mixture contained much more acetylene than could ever get into the air of a room, and in fact in a dwelling house a much smaller quantity would produce an explosion.

A dog was killed by breathing 40% acetylene and 20% oxygen in 51 minutes; another in about 30 minutes by 80% acetylene and 20% oxygen. A guinea pig was *not* killed in 39 minutes by the same mixture.

L. Brociner (Comptes Rendus 1895, II., 773) had made similar experiments in 1887, and concluded that acetylene was not poisonous. It is not more absorbed by blood than by water. It has *no* specific action on blood. Sulphide of ammonium reduces such blood normally. It has no special absorption band.

Berthelot and Claude Bernard 30 years ago found acetylene not poisonous.

Moissan (Comptes Rendus, 1895, II, 566) says pure acetylene only has an ætheric agreeable odor.

Bistrow and Liebreich in 1868 (Ber. I., 220) pronounced acetylene poisonous, but this opinion is contrary to that of Berthelot and of Claude Bernard, and Berthelot has recently stated anew that pure acetylene is not poisonous, and has pointed out that the old method of preparation of acetylene by means of the acetylide of copper may contaminate the gas with prussic acid (Comptes Rendus, 1895, II., 566). It may be concluded then on the best authority that *pure* acetylene is not poisonous.

The smell of freshly prepared acetylene made with commercial carbide of calcium would lead one to suspect that the gas contained phosphoretted hydrogen and Wellgerodt (Ber. 1895, 2107, 2115) detected its presence in acetylene by passing the gas through nitrate of silver solution. I also got by another method a good molybdate test for phosphoric acid, before I knew of the above publication.

The phosphorus is probably derived from phosphates in the quicklime and in the ash of the coke used for making the carbide of calcium. Moissan used a pure carbon obtained by charring sugar, and his carbide gave pure acetylene free from disagreeable odor. The previous statements that acetylene is innocuous may only apply to pure acetylene, and it is important then to make a special examination of commercial acetylene to see if it contains dangerous constituents. I have only found one statement on this subject contained in the *Electrical Engineer*, New York, November 13, 1895, p. 469.

Dr. W. H. Birchmore says that 1 cu. ft. of acetylene in 10,000 cu. ft. of air produces headache in twenty minutes, and that so small a quantity of acetylene is not perceptible to smell.

I have frequently breathed air containing enough acetylene to be very plainly noticeable from its smell, and have not suffered the slightest inconvenience. It seems probable that individuals differ greatly in their susceptibility to poisons of the class to which phosphoretted hydrogen belongs. It is also quite possible that other poisonous gases in very small quantity may constitute impurities of acetylene. Dr. Birchmore performed a single experiment upon an animal and states that one part of acetylene in 10,000 parts of air killed a guinea pig in six hours; sickness came on in ten miutes. The blood lost its power of absorbing oxygen, as in a case of poisoning by cyanhydric acid. He did not examine the blood for acetylene. Experiments of this kind should be repeated by competent physiologists, and the blood should be carefully tested. It is quite certain that in this case the death was caused by some other body present and not by the pure acetylene.

If it is found that phosphoretted hydrogen or some similar impurity is present in dangerous quantity, they can probably be removed by a proper treatment of the gas.

Arsenuretted hydrogen might also be present, but I have failed to find any trace of it in commercial acetylene.

It has been said that acetylene gas could never act as a poison, because an escape from a leaky pipe would attract the attention of a person, even while asleep, by its irritating action upon the throat, producing coughing. The statement is contrary to all my observations.

Further experiments upon this subject are required, but the evidence already accumulated seems to be favorable to acetylene as compared with water gas, and if the new illuminant can be made for a reasonable price and can be quite freed from poisonous impurities it should become a formidable competitor with water gas. On the other side, however, we shall find that the danger from explosion will call for special precautions in the use of acetylene gas.

DANGER IN USE OF LIQUIFIED ACETYLENE.

There will be an evident advantage, if acetylene gas lighting succeeds, to begin by introducing it without putting down mains and setting down generating houses; this can be done by supplying customers with liquified gas. A cylinder holding say 1,000 cu. ft. gas compressed in a space of less than 2 cu. ft. can be attached to the gas pipes of a house in place of a meter.

This new gas service is, however, not so simple as would at first appear. Two cylinders must be used at once, or at least a second one must be brought before the first is exhausted to make the supply continuous, otherwise we should have the disagreeable surprise of finding the gas extinguished. A gauge on the cylinders must be watched to see when No. 1 must be cut off and No. 2 turned on. Neglect in care of this will cause extinction of the gas and discredit of the system. The gas companies have accustomed us to a constant supply through mains at an even pressure and have set a high standard of convenience.

The cylinders contain gas at a pressure of 6 to 700 lbs. A reducing valve, always kept in order, must reduce this pressure to 1 oz.=2 inches water. The Pintch valve employed on railroad lines is used, but we must ask the question: Will it always keep in order with the care it would get in a private house or tenement house? Then an escape valve is required in case a fault of the Pintch valve throws the whole pressure on the pipes. A mercury seal would answer to empty the gas into the air, and it could be counted on to work satisfactorily, but the gas would be lost each time that the valves got out of order.

All this apparatus makes the use of liquified acetylene somewhat complicated, and in addition to this disadvantage it would present a serious danger in case of fire. The cylinders when strongly heated would be liable to explosion, and it is proposed to guard against this danger by employing a mercury seal to empty them when the pressure exceeds safe limits. This arrangement, even supposing that it always performed its office during a fire, would be open to a serious objection, for if the fire took place in a large building in a town containing, say, 10 cylinders with 5,000 cu. ft. of gas in the 10, this quantity of gas thrown in the air would make an explosive mixture with 20 times its volume of air, or about 100,000 cu. ft. in all, and whether disengaged on the roof or in the street would expose the firemen to a new danger.

If we add to the small annoyances arising from the care of a gas supply which is not constant like that of gas delivered in mains, the danger of explosion of a cylinder weakened by rust or neglect, the danger in case of fire and the very doubtful economy of the systems, the summary seems unfavorable to use of liquified acetylene, except in places where sufficient space can be had to isolate the cylinders as gasoline tanks are now isolated.

It will be seen later that these cylinders may be exposed to a special danger, although a very improbable one, from the explosive decomposition of acetylene under the impulse of a certain kind of shock.

THE TEMPERATURE OF THE ACETYLENE FLAME.

When we compare acetylene and common gas illumination from the point of view of the products of combustion which vitiate the air of a room, or of the heat which is given off, the conclusions are very favorable to acetylene lighting, because ten times as much common gas has to be burnt to obtain the same amount of light as would be given by a unit measure of acetylene. The heating effect, however, is not in the ratio of ten to one. Ten cu. ft. of Boston gas give 2.42 times as much heat as 1 cu. ft. of acetylene.

Prof. Lewes* has calculated the amount of carbonic acid given off by different illuminants, and finds, for an equal amount of light, that coal gas gives off six times as much as acetylene, and he estimates that the heat from acetylene would not be much greater than from the ordinary incandescent lamp.

The true relations are for the same amount of light: Heat from incandescent light, 1; acetylene, 3; water gas, 9.

Prof. Lewes says, in the same connection: "The flame of acetylene, in spite of its illuminating value, is a distinctly cool flame, and in experiments which I have made by means of the Lechatelier thermo-couple, the highest temperature in any part of the flame is a trace under 1,000° Cent. While coal gas, burning in the same way in a flat-flame burner, the temperature rises as high as 1,360 Cent."

* A paper read before the Society of Arts, London.

It is not an advantage, but a disadvantage, that the fishtail acetylene flame should be cool. Its temperature is lowered by the excessive contact with air required for complete combustion, and, if the flame could be made hotter, more light could be obtained for the same quantity of heat. It is scarcely necessary to add that the temperature of a flame has nothing to do with the heat of combustion. Phosphorus or sodium can be burnt at the ordinary temperature, or at a red heat, and the heat of combustion is the same at either temperature, provided the products of combustion are the same.

Lechatelier,* one of the best authorities upon such a subject, does not appear to have measured the temperature of the acetylene flame with his pyrometer, and, in fact, such measurements are very difficult; but he has calculated that acetylene, burned with air, may reach a temperature of 2100° to 2400° Centigrade, and, burned with oxygen, 4000°.

It is easy to melt platinum in a common air blowpipe flame fed with acetylene, but the platinum appears to first form a carbide.

Acetylene, notwithstanding its high cost, may find a restricted use in the laboratory in air or oxygen blast furnaces; it will undoubtedly give a higher temperature than gas or hydrogen.

The preceding description has continually held in view the utilitarian side of the question, and it has been thought simpler to enumerate the items in favor of the economical use of acetylene as compared with gas and not to extend the comparison to other forms of illumination, but the following table mostly taken from the most recent book† on the subject gives the means of

* Comptes Rendus, December 30, 1895.

† Julius Swoboda: Petroleum Industrie. Tübingen, 1895.

comparing other modes of lighting. It is to be remarked that authorities differ widely in their estimates, and the cost of gas and electric lighting varies greatly with the locality. Electricity is particularly advantageous when it can be put to other uses during a part of the day.

100 CANDLE LIGHT DURING 1 HOUR.

	Quantity.	Cost. Cents.	Heat of combustion. Kilograms of water 1 degree.
Arc light.	0.09—0.25E	1—2.5	57—158c
Incandescent lamp	0.46—0.85E	3—5	290—536c
Boston gas, $1 per 1000	20 cu. ft.	2.0	3380c
Acetylene, $10 per 1000	2½ to 3 cu. ft.	2.5—3	1000-1200c
Petroleum lamp	0.62 lb.-1.0 lb.	2.0	3360c
Carcel oil lamp	0. 9 lb.	8.0	4200c
Paraffine candle	1. 7 lb.	28.0	9200c
Spermaceti candle	1. 7 lb.	54 0	7960c
Wax candle	1. 7 lb.	61.0	8940c
Stearine candle	2. 0 lb.	33.0	9700c
Tallow candle	2. 2 lb.	32.0	

THE CHEMICAL PROPERTIES OF ACETYLENE.

A series of very simple experiments will illustrate the most important properties of acetylene.

To compare its density and its explosive force with those of common gas take two lamp chimneys closed at the top and bottom with corks, and each fitted with an inlet tube at the bottom and with a large brass tube at the top. Fill one with gas and the other with acetylene and light both gases at the upper tube; then remove the rubber tubes from the inlet tubes. The flames will continue to burn at the upper orifice, because each gas rises, floating on a layer of air, which rushes in from below, and the relative densities of the gases may be estimated from the rapidity with which each flows out. The common gas flows out more rapidly and burns with a higher flame than the acetylene, because it is lighter: (density of Boston gas=0.607; density of acetylene =0.91). At the last the flame strikes down into the small residue of each gas, which has become mixed with air in the lamp chimneys, and a slight explosion takes place, which is notably stronger with acetylene than with gas. The greater density of acetylene explains partly why it should have more illuminating power than common gas, since a cubic foot contains more material. As our object is only to examine the properties of acetylene which have a bearing upon its illuminating power, one test of its chemical activity will suffice. Set free a small quantity of hypochlorous acid gas in a tall glass jar and plunge into it a tube from which a stream of acetylene is issuing, this latter will immediately take fire from the great heat evolved by its chemical action upon the hypochlorous acid. If common gas, or almost any other gas, were subjected to the same test no flame would result.

Acetylene forms peculiar salts with copper, silver and mercury; and these when dry decompose explosively when subjected to a shock or to the action of heat. The silver compound can even be exploded under water and is more dangerous than fulminate of silver.

EXPLOSIVENESS OF ACETYLENE.

What we have learned concerning the extreme chemical activity of acetylene leads us to expect that it would form more readily than other gases an explosive mixture with air, and this proves to be the case.

Experiments using a piece of two-inch gas pipe as a cannon show that 5–6% of acetylene mixed with air forms an explosive mixture; 10–12% of water gas is required to explode with air.

The heat abstracted by the walls of the iron tube prevents the mixture from obtaining its limit of explosiveness, and a still smaller percentage of either gas mixed with the air of a room would explode. Lechatelier (Comptes Rendus, 1895, II., 1145) gives 2.8% of acetylene mixed with air as the explosive limit, and it is to be noticed that in a dwelling house the danger from explosion is enhanced by the inequality of such mixtures. A flame spreading from a spot rich in gas would propagate itself explosively through a mixture very poor in gas.

The danger is enhanced in the case of acetylene by the low temperature at which it takes fire, 480° Cent. Most other gases must be treated to about 600° to take fire and marsh gas, the fire damp of mines, fortunately requires a much higher temperature to ignite, so that a spark from flint and steel does not suffice to cause an explosion. Acetylene burns with greatest increase of volume when the products are carbonic oxide and hydrogen. The violence of combination of acetylene with oxygen can be well shown by igniting equal volumes of the two gases. A quantity equal to 3–4 grains makes a far louder report than the same weight of powder or of nitro-glycerine.

The dangerous properties shown by acetylene need not condemn it, but particular care must be taken to prevent leakage if acetylene gas comes into use; fortunately small pipes can be used and the gas contains no ammonia, which, in common gas, destroys the grease on the stopcocks and promotes leakage.

If instead of igniting a mixture of air and acetylene, the latter alone is passed through a glass tube heated to dull redness, at first a slight change takes place, and liquid benzene and other products condense in the colder parts of the tube; at a little higher temperature the change goes further—carbon is deposited and hydrogen is set free. If the interior of the tube is carefully watched it will be seen that the decomposition takes place with a dull red flame, as if the acetylene were burning with an insufficient supply of air. No air, however, is in the tube; there is no combustion in the ordinary use of the word, and yet we have in the flame evidence of a sudden disengagement of heat. Here we approach the solution of the problem, regarding the extraordinary chemical activity of acetylene. Acetylene has a supply of heat stored up, which it gives off, whenever it is decomposed spontaneously, burnt in air, or excited by any radical chemical change. The sudden evolution of heat manifests itself as light, quickens combustion and promotes all chemical action.

The exact quantity of heat absorbed and stored up by acetylene, when it is formed by the union of carbon and hydrogen, can be best measured by two experiments. Firstly, burn exactly one cubic foot of acetylene in a calorimetric apparatus, which is merely a device for heating a given weight of water without loss of heat, and find that nearly nine pounds of water can be heated from its freezing to its boiling point. Or, if we take the thermal unit in more general use we find that 407 kilograms of water gain one degree Centigrade in temperature from the heat given off by burning one cubic foot of acetylene gas, measured at 0° Cent. and 76 cm. barometer.

Secondly, take exactly the weights of carbon and hydrogen which correspond to the weight of one cubic foot of acetylene and burn them in the same way under a weighed quantity of water. We shall find that according as we take pure amorphous carbon or diamonds we get a somewhat different quantity of heat. With amorphous carbon and hydrogen 336.5 kilograms of water are raised 1 degree Cent. in temperature. The difference of heating power then between acetylene gas and the same weight of carbon and hydrogen is 71 heat units. The surplus energy stored up in the acetylene and set free when it is burnt becomes evident and is measured, when we find that the acetylene arrangement or combination of carbon and hydrogen atoms is capable of making the elements do more work, that is to heat 71 kilograms more water than when the same elements are free in the state of amorphous carbon and of hydrogen gas.

When the carbon from carbide of calcium and hydrogen from water combine to make acetylene heat is utilized in changing the carbon from the solid and the hydrogen from the liquid form to the form of a gas. Heat is absorbed in this process which imparts a new energy of motion to the atoms, in the same way that heating water separates the particles to two thousand times wider distances from each other and gives them the energy of motion which is apparent in steam. In this case we can measure the amount of heat required for this work and which is absorbed while it takes place. Unfortunately we can not get similar measures with carbon vapor and solid carbon, and we can only measure a total absorption of heat during the generation of acetylene, and we suppose that the total, 71 heat units, may be made up by the absorption of a larger amount of heat in order to change amorphous carbon to the gaseous state, from which must be deducted the heat which is given out when two carbon and two hydrogen atoms combine to make C_2H_2. Benzene which has exactly the same percentage of carbon and hydrogen, but combined into quite a different chemical group shows that more energy has been expended in bringing about its chemical arrangement. The signs which attest this are greater stability, smaller chemical activity, and above all the fact that when benzene is burnt it gives off much less heat than the same weight of acetylene does, and in fact only 4 heat units more than the same weight of carbon and of hydrogen.

It has seemed necessary to explain fully how quantities of energy, which can usually be measured in terms of heat, preside over the making of different chemical compounds, and how the dormant heat can be made active again when the compounds are excited to chemical change, and how each one is stamped as with a birth mark by its special heat value.

This peculiar stamp set upon acetylene is at the same time a token of valuable and also of dangerous qualities. Heat is added to the heat of combustion and brings about more sudden changes and places acetylene with the class of bodies known as fulminates. These are distinguished from explosives like gunpowder by their capability of suddenly evolving stored-up heat, which causes a great expansion of gaseous products. Berthelot has calculated that fulminate of silver develops a pressure of 600,000 fbs to the square inch in the incredibly short time of one-thirty-millionth of a second. The acetylide of silver has similar properties, and the lightest shock suffices to explode it. It occurred to Berthelot to see whether acetylene gas might not decompose spontaneously into carbon and hydrogen with explosive suddenness. We have seen that it decomposes into these products, *but without explosion*, when strongly heated, and only in one way could it be made to decompose explosively. Berthelot succeeded in detonating pure acetylene by subjecting it to the shock of fulminate of silver.

The danger seems very slight that acetylide of copper or some other metal may form in an acetylene gas-holder, and when exploded by friction or heat cause the whole mass of gas or liquid acetylene to explode. The subject, however, is worthy of further study.

As was said in the beginning, the problems which are suggested by this new industry touch on all sides upon some of the most important of the recent discoveries in chemistry and physics, and the ease with which acetylene can be obtained opens the door to many new experiments. Such questions, for instance, as the use of acetylene in gas engines, under special conditions, where the high price would not be prohibitive, would offer a very interesting study. It does not seem impossible that a gas so active and so easily stored might be exploded with air in a pneumatic gun to give an additional impulse to the projectile.

The laboratory experiments which have been described may perhaps serve as a guide in some directions to manufacturers, but they cannot settle the commercial details upon which the success of the new enterprise depends. Much further study and tests upon a larger scale, with the improvements suggested by prolonged trial, can alone decide whether the new illuminant is destined to supplant older industries built up slowly and surely by the persistent efforts of hard-working and skillful men.

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*NOTES ON THE CERRILLOS COAL FIELD.**

During August, 1895, the writer revisited the Placer, or Cerrillos, coal field of New Mexico, which is about 25 miles south from Santa Fé. The field is small, apparently a detached portion of the Laramie area extending far southward within the Rio Grande region.

The district of especial interest is a strip lying south from Cerrillos and Waldo, stations on the Santa Fé railroad. It is less than two miles wide and reaches southward to a little more than five miles from the railroad; but evidently all of the workable coal beds are shown, and the transition from bituminous to anthracite is exhibited very satisfactorily. The mines are on Coal cañon, which extends from the Placer, or Ortiz mountains, at the south, to Waldo, at the north, somewhat more than six miles.

The Ortiz mountains are largely trachytic; from them there extend northward two plates, each one about 200 feet thick, which lie between Laramie beds and follow their dip very closely. The upper plate covers the area east from Coal cañon and is now the surface rock, the overlying beds having been removed. It extends northward to somewhat less than two miles south of Waldo, terminating abruptly at the lower end of Madrid, where are the offices of the Cerrillos Coal Company. The lower plate, about 400 feet feet below the upper, does not come to the surface on Coal cañon, but it was pierced in a boring on the mesa immediately west and it crops in an arroyo within a few rods further west. Several dikes extend upwards from this plate, one, very large, seen west from Coal cañon, which must have been connected with the upper plate, as it rises very high above the mesa; a second, seen in Coal cañon, not more than 10 or 12 feet wide does not reach the upper plate; a third, very narrow, found in the same cañon at a mile and a half above Madrid, passes distinctly into the upper plate. Prof. Kemp examined the specimens from several exposures and recognized the close relation in composition throughout.

The stratified rocks within this strip belong to the Laramic and the exposed section is somewhat more than 1,000 feet thick. They resemble those of the same age in the Trinidad coal field, but shale is present in greater proportion. Limestone is apparently wholly absent and the sandstones are unusually non-fossiliferous. The coal beds are numerous, but most of them are very thin and several are not persistent in all of the sections.

The only coal beds of interest here are those in the interval between the trachyte plates; they are

White Ash coal bed	2′6″ to 7′
Interval	70′
Coking coal bed	1′ to 2′6″
Interval	80′
Cook-White coal bed	3′
Interval about	150′
Waldo coal bed	4′

*Abstract of paper read before N. Y. Academy of Sciences, January 20, 1896.

The *White Ash bed* is not more than 15 feet below the upper plate and the *Waldo bed,* as found in the bore hole, not more than 10 feet above the lower plate of trachyte.

The *White Ash* has been mined at many pits along Coal cañon for a distance of nearly three miles, beginning at about a mile and a half from Waldo. It is the important bed of the region and the only one now mined. Four pits, two of which are now in operation, show the bed. At the old Boyle mine, about a mile and a half above Madrid, the coal is a hard, dry anthracite, slipped and jointed throughout; some portions closely resemble the graphitoid anthracite of Rhode Island.

The Lucas mine at Madrid was idle when visited, but work had been stopped for only a short time. The southerly levels of this mine yield an anthracite of excellent quality, equal in appearance and composition to the average anthracite of Pennsylvania; but a rapid change is shown in the northerly levels. Jointing becomes annoying at a little distance from the slope, and the coal is wasted in the breaker; within 350 feet evidences of great pressure and disturbance accumulate, and the coal is laminated like that from some Vespertine mines of southwest Virginia, with the polished surfaces, often curved, frequently not more than one-fourth of an inch apart. This, however, is still anthracite, and work was stopped in these northerly levels only because of great waste in breaking.

The Cunningham mine, at the lower end of Madrid, entered a tender coal at the crop; the slope was pushed 1,100 feet, but no anthracite was found. The coal burns with flame.

The White Ash mine, about half a mile north from the Lucas, is the important pit. At one time trains might be seen coming from its slope made up of cars carrying, some of them anthracite, others the tender semi-bituminous, and others still the rich bituminous coal which has given this mine its reputation. The bituminous coal, containing 39 per cent. of volatile combustible, is obtained from the northerly levels, but the southerly levels yield for the most part what is called tender coal. The latter is dull, very tender, and much of it has an almost cone-in-cone structure. It is reached in the southerly levels at varying distances from the slope. The passage from bituminous into anthracite through this tender coal is shown in the sixth level southerly where tender coal was reached at 125 feet from the slope and anthracite at 450 feet. The passage is gradual. The anthracite makes its appearance at the bottom and thickens gradually, crushed coal being replaced by laminated and that by the harder almost homogeneous coal, the change being completed within 50 feet.

The *Coking bed* was worked some years ago at about two miles above Madrid, where its coal was coked in ricks.

The *Cook-White* is no longer mined, but it has been opened at many places along Coal cañon, and the changes in character of the coal are clearly shown. Above Madrid fragments on the old dumps show that the coal is anthracitic; a pit at the lower end of Madrid, almost midway between the Cunningham and White Ash mines, shows a tender coal which bears some resemblance to that from Pocahontas, in Virginia; analysis shows that it contains about 30 per cent. of volatile, which is about what should be expected, if its changes are similar to those of the *White Ash.*

The *Waldo bed* is not reached in the upper part of Coal cañon, but it has been mined extensively further down. The only interest it has here is its existence in the bore hole west from Coal cañon, where it is not more than 10 feet above the lower plate of trachyte and shows no evidence of any metamorphism whatever.

Long ago Newberry, and afterwards Stevenson, regarded the coal as metamorphosed by heat from a great dike of eruptive rock following the northerly side of the Placer (now Ortiz) mountain. This, which then was but a suggestion, is sufficiently clear as an explanation now. As the center of eruption was in the Ortiz mountains the metamorphism should be most notable near those mountains. That is distinctly the condition, for, at the most southerly point showing the *White Ash bed* well, the anthracite is very hard; but the change is less toward the north until normal coal is reached in the White Ash mine below Madrid. The gradation is equally clear in the *Cook-White bed*; but the small bed between the main seams appears to contradict the hypothesis, as it is decidedly bituminous at half a mile above the pit, where the *White Ash bed* yields the hardest anthracite observed. This condition is easily explained by the fact that the small bed is not continuous, being broken by clay seams several feet wide, which sometimes cut out all of the coal; these seams would prevent the passage of heat from one portion to another.

The conditions at several localities show that mere proximity to the mass of eruptive rock was insufficient to produce change. The lower plate of trachyte is but 10 feet below the *Waldo coal bed* in the bore-hole west from Coal cañon, but, though 200 feet thick, it had no appreciable effect upon the coal. The interval between the *White Ash bed* and the upper plate of trachyte shows insignificant variations along Coal cañon, and it must be approximately the same in the newer parts of the White Ash mine; yet in the Lucas mine and at all localities south from it the coal is anthracitic; whereas at all points north from it to the border of eruptive rock one finds only transition coal. It seems clear that direct contact is necessary to produce change.

Prof. J. F. Kemp describes the eruptive rock as a trachyte closely allied to andesyte. Its outflow then was early, possibly at the time of the Laramide elevation, when great outpourings of andesyte occurred in Colorado, Utah, Wyoming and Montana. The coal was completely formed prior to this elevation, prior to any disturbance, there being not only no evidence of pulpiness, but every evidence that the coal was thoroughly hard. It was crushed into minute fragments, slicken-sided, like the Utica shales of Franklin county, Pa., or laminated and rolled into leaves, like the Vespertine coals of southwestern Virginia. The process of conversation was complete before disturbance not merely in the lowest beds, but also in the *White Ash bed*, at nearly 900 feet above the bottom of the Laramie.

JOHN J. STEVENSON.

THE RÖNTGEN PHENOMENA.

A FEW EARLY RESULTS OBTAINED AT THE UNIVERSITY OF PENNSYLVANIA.

THE first attempt here to repeat Röntgen's experiments was made on Wednesday, January 22d, but without success, owing to the impression obtained from early accounts of experiments abroad that two induction coils were necessary. As a matter of fact, one coil giving a four-inch spark through air is quite powerful enough to produce most of the results that have yet been obtained. The average current through the primary is about three amperes with an E. M. F. of twelve volts. Our tube is a beautiful large pear-shaped one, admirably adapted for the purpose. It is about 27 cm. long, and 11 cm. in diameter at the largest end.

Fig. 1 shows the result of a test to demonstrate the possible reflection or refraction of the X-rays when incident upon two very large and white diamonds set in a ring. The gems were placed within a purse with some coins. Certain features of the cutting seem to be very marked, and the interpretation of the result obtained presents a very interesting problem.

FIG. 1.

We have also demonstrated the possibility of detecting by the Röntgen process flaws or blow holes in metal plates. The writer had prepared for him three pieces of aluminum about 5 mm. thick, within which were made several hidden flaws and holes, and in one of them was placed a plug of some foreign substance, lead. A picture of the pieces reveals exactly the positions of all the holes, and a darker streak shows the position of the lead plug. Even the numbers which were stamped with a die are plainly visible in the radiogram.

It is now desired to call attention to a very interesting incident in connection with this wonderful discovery. The writer has in his possession a plate showing the impression of two coins taken on February 22, 1890, in the physical department of the University of Pennsylvania, undoubtedly by the X-rays.

On the occasion referred to many experiments were made, the object being to photograph the brush discharge, from a powerful induction machine, directly upon the sensitive plate, without any camera. Incidentally also the impressions of coins were obtained by sparking them when in contact with the sensitive film. After these experiments had been completed, a number of Crookes tubes were brought out and operated for the pleasure and amusement of Mr. W. N. Jennings, in connection with whom the work had been done.

A few days later Mr. Jennings, who had taken the plates home for development, reported the appearance, on one of them, of too very mysterious discs quite different in character from those obtained by the sparking process. No explanation was found at the time to account for the phenomenon, and the matter was forgotten till recently, when the occasion was recalled and the old plate was produced from a lot of so-called failures. On repeating the experiment by operating a Crookes tube for ten minutes, in the vicinity of an enclosed photographic plate having two coins on the outside of the box, it is found that the coin shadows are strikingly similar to the mysterious discs upon the old plate. The blurred appearance of one edge is a distinctive feature of a Röntgen picture. A print from the original plate is shown in Fig. 2. The writer and his associate wish

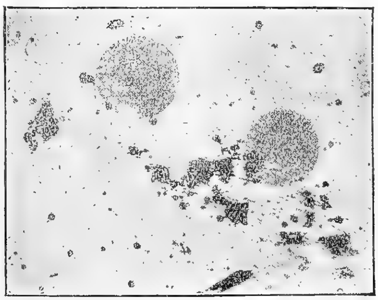

Fig. 2.

to claim no credit for the interesting accident, but the fact remains that without doubt the *first* Röntgen picture was produced on February 22, 1890, in the physical lecture room of the University of Pennsylvania. ARTHUR W. GOODSPEED.

UNIVERSITY OF PENNSYLVANIA.

CURRENT NOTES ON PHYSIOGRAPHY.

CATSKILL AND HELDERBERG ESCARPMENTS.

RECENT reports of the New York State Geologist contain chapters by N. H. Darton, from which a number of interesting physiographic paragraphs may be selected; and inasmuch as there is no good account of the geography of the Empire State, all these piecemeal contributions toward it are welcome. The Helderberg escarpment in Albany county rises boldly over the broad alluvial plain formed by the Mohawk during the 'Champlain' submergence. Back of the escarpment the land rises in successive rock terraces of moderate height. The Catskill escarpment in Ulster county is the strongest feature of the kind in the eastern part of our country. Subordinate characteristics of this dominant form are found in the capture of the headwaters of certain consequent upland streams by the obsequent Kaaterskill and Plaaterskill, which are gnawing deep 'cloves' in the steep face of the escarpment and thus gaining drainage area for the subsequent Hudson valley. Among the ridges in the foreground the complicated monocline of Medina sandstone forming Shawangunk mountain is the most conspicuous. A number of geographical illustrations accompany these reports, but their reproduction is disappointing in several cases.

EXPLORATION IN LOWER CALIFORNIA.

AN account of a collecting expedition to Lower California by G. Eisen (Proc. Cal. Acad. Sci., V., 1895, 733–775), gives some notes of interest on the features of the extremity of the peninsula. Winter rains are light and rare; late summer rains are frequent and come in comparatively heavy showers; the withered shrubby growth on the mountain slopes bursts into leaf and flower when the rains begin. Very brief mention is made of raised beaches and of 'moraines,' which are described as prominent, large and steep, especially on the east slope of the mountains, where they 'all run more or less parallel from west to east' (754). The mountains, being only 7,000 or 8,000 feet high, and their eastern slope being drier than the western, it seems questionable whether these so-called moraines are authentic records of glacial action. Possibly they are dissected alluvial fans, which have not infrequently been mistaken for glacial deposits.

NIUAFOU, A VOLCANIC RING ISLAND.

LIEUT. SOMERVILLE, of the British navy, contributes an account of this remarkably perfect ring island to the London Geographical Journal for January. It lies midway between the Fiji and Samoa groups, remote from other islands. Its outer diameter is about three miles, the whole coast line consisting of forbidding black lava rocks. The caldera is about two miles in diameter, with interior cliffs of 200 or 300 feet in height. On the eastern side of the deep lake here contained is a peninsula formed by the craters of the eruption of 1886. The view from the commanding summits of the caldera ring is described as of remarkable beauty, including a great expanse of the surrounding ocean rolling under the southeast trade, the calm lake within the basin, the luxuriant vegetation on the older slopes, and the barren cinder cones of the recent outburst. A good sketch map and two views are reproduced.

THE FÆROES.

AN account of the Færoes, or Sheep Islands, is presented to the same journal by Karl Grossmann, as the result of visits made in three recent summers. The islands result from the deep dissection and submergence of a great volcanic mass, whose nearly level lava beds determine the tables and cliffs which dominate the scenery. The exposed coasts are cut back into great sea cliffs, some of which rise 1,500 to 2,400 above the sea, exposing magnificent structural sections. Huge outstanding stacks remain in front of many cliffs.

The outer islands are reached only in fair weather and then with difficulty; their small population often being storm bound for weeks at a time. Sea birds, nestling on the cliffs, constitute an important article of food supply; the 'bird rocks' forming valuable property for the parishes to which they belong. Here the hardy custom of bird catching, while dangling from a rope let down from the cliff top, is still in practice. 'Tidal whirlpools' occur in the inner fiords; some have a diameter of thirty yards; their smooth surface, bordered by a rippling cascade, standing half a foot above the surrounding water.

MOUNTAIN WASTE IN RELATION TO LIFE AND MAN.

AMONG the *Anthropogeographische Beiträge*, edited by Ratzel (Wiss. Veröffentlichungen, Ver. f. Erdk., Leipzig, ii, 1895), is an essay by Bargmann on the forms assumed by the youngest waste building talus slopes and fans on the flanks of the northern Kalkalpen, in their relations to mountains, snow, water, plants and mankind. Various forms assumed by the waste are minutely classified. The already large area covered by waste slopes is shown to be increasing, while the naked rock area is decreasing; thus the opportunity for occupation of the mountain district by various forms of life is on the whole improving. Yet in the present phase of degradation, the modern invasion of meadows by the advancing foot of waste slopes has in a number of cases seriously reduced the value of the valley floors as pasture grounds. Some slopes of loose waste descend at angles of 44 and 46 degrees. The chapter on the manner in which waste slopes are taken possession of by plants is an excellent illustration of the relation of physiography to botany. W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

WAS SYPHILIS A GIFT FROM THE AMERICAN RACE?

No doubt there is a racial nosology as well as physiology. Many writers have asserted that syphilis originated in America and was first introduced into Europe by the sailors of Columbus. Dr. Joseph Jones claims to have unearthed bones showing syphilitic caries from the ancient graves of Tennessee. In the *Journal of Cutaneous Diseases*, October, 1895, Dr. A. S. Ashmead argues that syphilis was autochthonous among the Aymaras of Bolivia, and quotes Forbes as to the possible origin of it from the alpaca, an animal which suffers from it in a malignant form. Dr. E. Seler, in the *Verhandlungen* of the Berlin Anthropological Society for 1895, has a learned article to support the view that it was prevalent in Mexico before the conquest.

On the other hand, in the same volume, (p. 454), Prof. Virchow declares he never saw a syphilitic bone from an ancient American grave; that the disease was known in Europe certainly as early as 1472, and was prevalent in Japan in the ninth century.

ETHNOLOGY, GEOGRAPHY AND HISTORY.

THE relations of these three sciences are discussed by T. H. Achelis in the *Globus* 1896, No. 4. He regards ethnology as a strictly empirical study, 'wholly without metaphysical tendencies.' Its ultimate aim is to define the human soul by a thorough collation of all that it has actually achieved, as in religion, mythology, law, art, etc. In primitive conditions man's activities are powerfully influenced by his geographic environment, but this diminishes as culture increases. The proper aim of ethnography is not to search out relations of blood, but similarities of culture. Above these stand the universal traits of human psychology, which can be defined only by careful collection and comparison of ethnic details. Degenerations and deteriorations in culture do not belong of right to ethnologic study, because this has as its purpose the definition of evolution or the advancement of the species. He refers to Post, Bastian, Ratzel and Andree as the best representatives of this new school of ethnology.

It is proper to add that their opinions have not yet received universal, scarcely general, acceptance from other nations.

MENTAL VERSUS PHYSICAL IN WOMAN.

There is a prevailing impression that women in the higher classes of civilized society are less desirous and less capable of having numerous offspring than those of the lower classes and ruder conditions. In other words, that there is an antagonism between the intellectual culture of woman and her reproductive powers. One or the other must suffer in her education.

The sociological importance of such a fact, if it is one, can scarcely be over-estimated. Were it proved, and no remedy be found, it would mean the gradual extinction of the most cultured classes in the community. The question was presented by me before the anthropological section of the Academy of Natural Sciences, Philadelphia, and an abstract published in the *Medical News*, January 18, 1896, under the title 'The Relations of Race and Culture to Degenerations of the Reproductive Organs and Functions in Woman.' I shall be glad to send a copy to any reader of Science who wishes one.

D. G. Brinton.

NOTES ON AGRICULTURE AND HORTICULTURE. (IV.)

TREATMENT OF PEACH ROT AND APPLE SCAB.

Delaware is a small State, but large in its peach industry. The leading enemy to the peach crop, the fruit rot, naturally is a subject that demands the attention of the Station Mycologist, Prof. F. D. Chester. For several years he has been testing various fungicides for the rotting of the fruit, and the last bulletin (No. 29), recently issued, gives both the results of the experiments and general directions for spraying. It is recommended to remove and burn all dried or mummified fruit from the peach trees in winter and to spray the trees in early spring with bluestone solution. When the fruit buds begin to swell spray with the Bordeaux mixture and again just before the buds open. Spray again with Bordeaux when the bloom is falling, and add a little Paris green to keep off the curculio. About two weeks later the same treatment is repeated. As the Bordeaux coats the fruit with the lime mixture, for the last two sprayings copper acetate, a colorless solution, is employed. A tenfold increase of sound fruit was obtained by this process at a cost of about twelve cents per tree.

The treatment for apple scab was the Bordeaux mixture, to which London Purple had been added and applied five times to the trees. The good fruit was doubled by this treatment, while the general health of the apple trees was much improved.

LEGISLATION AGAINST WEEDS.

The division of Botany U. S. Department of Agriculture has just issued a bulletin (No. 17), prepared by Mr. L. H. Dewey, "in response to a growing demand among agriculturists and Legislators for data which will enable them to prepare laws better adopted for the control of weeds than those now in use." One per cent. of increase in the crops, which might be obtained by weed destruction without much cost, would amount to $17,000,000. The passage of proper laws against weeds is important and should be effected with dispatch.

The weed laws are listed as found upon the statute books of the following States: Arizonia, California, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Vermont, Washington, West Virginia, Wisconsin. Thus twenty-five States and Territories have laws against weeds. In some States the law is to suppress but a single species, as against Canada thistle in California, Delaware, Kentucky, while other States proscribe fourteen, as in Minnesota and Ohio. The largest proscription is with the Canada thistle, twenty-one out of twenty-five States. Six States legislate against the Russian thistle.

The fact that there is no federal law against weeds is probably because no one species is national in importance, but the Russian thistle may become such if it spreads as it is feared.

The basis for a general weed law is given and includes as a leading feature a commission of which the State botanist shall be the head. It is very important that new weeds shall be recognized and measures taken to eradicate them at once. Legislation for the purity of seeds will do much to check the introduction of weeds through commercial seeds.

BACTERIA IN THE DAIRY.

DR. CONN gives a 'year's experience with Bacillus No. 41 in general dairying' in the Annual Report of the Storr's Experiment Station of Connecticut. This germ can produce a pleasant flavor in butter, if favorably situated in the cream, and is feasible in the hands of ordinary dairymen. The flavor thus produced is retained by the butter for a long time. It is not proved that this bacillus is the best possible one for this purpose, but Dr. Conn thinks the method is at least correct in principle and will succeed in practice.

SUB-IRRIGATION IN THE GREENHOUSE.

THE Ohio Experiment Station is taking a lead in the study of irrigation under glass by Prof. W. J. Green. In a recent bulletin the construction of the greenhouse with iron frames and bench tiles is fully shown by engravings, as also the great difference in the size of lettuce grown with sub-irrigation and surface watering, it being twice as large with the former as the latter method. The idea of irrigating below the surface grew out of an attempt to prevent the rotting of lettuce by not wetting the foliage. Sub-irrigation is cheaper than the old method of surface watering; the soil remains in a better condition and the plants are less liable to decay. These results come largely from the soil permitting the air to pass freely through it, besides supplying water constantly to the roots.

GRAPE CULTURE.

SOME of the Experiment Stations bulletins are books and not small ones. Sixty-four pages of close print interspersed with engravings is issued by the Georgia Experiment Station as its bulletin No. 28. The Horticulturist H. N. Starnes does not conceal the intent of the publication, but at the outset states that "no attempt has been made to treat the subject from a scientific standpoint, and as far as possible all technicalities have been avoided, as the bulletin is intended solely for the practical guidance of the inexperienced beginner." The booklet is divided into nine parts, namely, the vineyard, propagation, planting, pruning and training and so on.

BYRON D. HALSTED.

RUTGERS COLLEGE.

SCIENTIFIC NOTES AND NEWS.

THE WOODS HOLL MARINE BIOLOGICAL LABORATORY.

THE Eighth Annual Report of the Trustees of the Marine Biological Laboratory at Woods Holl has just been issued, and shows that the summer of 1895 was the most successful in the history of the Laboratory. At different times during the summer there were 63 investigators present, 42 of whom occupied special research rooms. There were 101 students taking introductory courses. The whole number of students who have attended the Laboratory since 1888 is 483. The attendance of investigators has been very greatly increased by the system of coöperation with the colleges and societies, which began in 1894. At present 25 colleges subscribe for investigator's rooms, besides five societies, including the American Association for the Advancement of Science and the American Society of Naturalists.

The year has been a successful one financially owing to the large number of students present who have paid for their instruction or through the colleges for the investigators' rooms or tables. A few years back it was necessary to make up a large deficit at the end of the year, while the past year's income exceeded the total expenses by nearly $1,000. There still remains, however, a debt of $5,985. Since this report was prepared, a meeting of the Trustees was held in Boston to revise the constitution of the Laboratory, and the following general plan was submitted: To place the entire financial interests of the Laboratory in the hands of a special finance committee. Second, to constitute from the present Board of Trustees a number of committees. Finally, to constitute from the staff at Woods Holl and from representatives of coöperating colleges a scientific board of direction, who, with the Director, will control the entire policy of the Laboratory and its general administration.

Encouraged by this successful year the Director, Professor C. O. Whitman, naturally closes with a strong appeal for an expansion of the resources of the Laboratory in the form of endowments. He proposes that tables shall be endowed at $1,250; investigator's rooms at $2,500; scholarships at $200, and fellowships at $500. The library needs $1,000 per year to keep it supplied with current publications. The publication fund should amount to $2,000 annually. But the chief feature of the proposed expansion is a main building for the exclusive use of investigators, providing for library, auditorium, aquarium, laboratories, etc., which would cost about $100,000. These steps would be necessary to found an inter-collegiate Biological Station, with an annual outlay of not less than $50,000.

In order to support this ambitious plan, the Director presents an exceptionally full and able report, tracing the whole past history of the Laboratory. His main contention is that the Laboratory was founded for *instruction* as well as for *investigation* in Biology, and that at the outset it was proposed to establish an ideal Biological Station, organized on a basis broad enough to represent the important features of the several types of laboratories hitherto known in Europe and America. The report aims to show that the elementary instruction department (a feature which distinguishes the American station from all those in Europe) is necessary in order to train the investigators, or, to use his own language:

"The instruction cannot be made too strong, for its strength is continually being transferred to investigation; and every proper expansion of investigation must react to improve and enrich instruction." He goes on to say that the instruction has not interfered with investigation, because the investigators have increased almost as rapidly as the elementary students. There were 9 investigators in 1888 and 63 in 1895. There were 8 elementary students in 1888 and 101 in 1895. He concludes: "Comparing the last four years of growth with the first four, it will be seen that we moved on with no very great gains in the earlier period, while the later period is marked by a sudden rise in standing, 50 per cent. of membership, and a gain of over 100 per cent. on the investigator's side. In 1894 a new laboratory was constructed and the Director recommends the construction of another temporary laboratory in 1896, in order to meet the pressing needs of the present growth. Much progress has been made in the general financial support of the Laboratory, which has hitherto fallen upon the generous Trustees from Boston and their friends, not only by the aid of the thirty coöperating colleges, but by the formation of the 'Biological Association,' the chief object of which is to aid the Laboratory in securing funds necessary to the foundation of a biological station as a National center of research in every department of biology. Local committees have also been formed, such as those in New York and Philadelphia."

During the year a large number of evening lectures were given by well-known morphologists and physicists, and the daily morning lecturers include a very large number of well-known names. Besides this, there has been regular instruction in vertebrate and invertebrate morphology and a course in embryology.

THE RÖNTGEN RAYS.

SOME twenty papers on the Röntgen rays have already been presented before the Paris Academy of Sciences. On February 10th M. C. Henry reported that coins coated with phosphorescent zinc sulphide lose their opacity to the rays. *Nature* thus summarizes the papers presented on February 17th: "In following up the analogy of certain properties of these rays with some properties of the ultra-violet rays, M. R. Swyngedauw has found that the X-rays cause a lowering of the explosive potential according to the same general laws as the electrically active ultra violet rays. Whilst the influence of the latter, however, is entirely suppressed by interposing a screen of wood, glass or blackened paper, these materials do not effect this property of the Röntgen rays. It was also noticed that these rays lowered the dynamic explosive potentials to a greater extent than the static potentials. As a result of the study of the property of the Röntgen rays of discharging an electrified body, M. A. Righi concludes that the time necessary for a given fall of potential is practically the same, whether the original charge be positive or negative. With an initial positive charge the discharge is not complete; but if negative initially, not only is the discharge complete, but the disc becomes positive. The results obtained by MM. J. J. Borgman and A. L. Gerchun, however, are precisely contrary to these, a positively charged disc losing its charge nearly instantaneously, and becoming negative on prolonged exposure to a Crookes' tube. MM. L. Benoist and D. Hurmuzescu contribute further researches on the same subject of a quantitative character. By measuring the time required for a given reduction of angle between the leaves of an electroscope and the distance of the leaves from the Crookes' tube, they prove that the ratio of the times are as the ratio of the squares of the distances. From the coefficient of transmission (0.85) of an aluminium plate, 0.1 mm. thick, it is shown that a plate of aluminium 15 mm. thick, such as was used by Röntgen in his original experiments, must be practically opaque to the rays *unless the rays are heterogeneous*. In an extract from a letter by de Heen an ingenious experiment is described which proves conclusively that the X-rays proceed from the anode, and not the cathode. A leaden plate perforated with holes is placed between the Crookes' tube and the photographic plates, and the direction of the bundles of rays obtained shows clearly that these rays are anodic.

ASTRONOMY.

THE Munich Observatory has just issued a very elaborate investigation of astronomical refraction from meridian circle observations made for this special purpose by Dr. Julius Bauschinger. The instrument used was the new six-inch, which was set up towards the end of 1891. The present series of observations are therefore the first ones made with this instrument. The method employed was the usual one of comparing the declinations or the same star obtained at the upper and lower culmination. The paper as a whole impresses one with the extraordinary care and thoroughness with which every part of the work has been done. We can, of course, only touch very briefly upon a few points that appear of special interest.

No corrections for errors of the microscopes, errors of division of the circle, or flexure of the tube, were applied to the observations, as very careful investigation of all these matters showed that the existence of such errors was not established with certainty. This speaks very highly for the skill of the instrument makers, Messrs. Repsold, of Hamburg. Great care was given to the reduction of the observations of the meteorological instruments, the pressure of the aqueous vapor in the atmosphere being taken into account. The corrections for variation of latitude which have been applied to the observations were deduced from the series itself, because the author did not want to let his results depend upon the work of others. Perhaps it would have been better to have employed some of the contemporaneous series of latitude variation observations for the correction of Dr. Bauschinger's results. They are not completely independent as they stand, because the constant of aberration was not determined from them. The usual Pulkowa value was used in the reductions.

Passing over a number of very interesting special investigations of various points, we shall call attention to the two most important results obtained by Dr. Bauschinger. He finds for the refraction constant at 760 mm. pressure, and 0° Centigrade, the value 60″104, indicating a considerable reduction of the Besselian constant. That such a reduction of the Besselian constant was needed, had already been shown to be probable by other recent investigations. The other important result is a very accurate declination catalogue of 116 principal stars for the epoch 1892. Radau's new refraction tables were employed throughout the work.

The Jablonowski Society, of Leipzig, has published in a book of 280 pages octavo, a treatise on the Secular Variations of the Orbits of the Major Planets by Dr. Paul Harzer, Director of the Gotha Observatory. This work has received the Society's prize. H. J.

GENERAL.

The Secretary of the Interior has requested the National Academy of Sciences to report on a forestry policy for the government with special regard to the following questions: (1) Is it desirable and practicable to preserve from fire, and to maintain permanently as forested lands, the wooded parts of the public domain, for the supply of timber? (2) How far does the influence of forest upon climate, soil and water conditions make a policy of forest conservation desirable in those regions where most of the public domain is situated? (3) What specific legislation is required to remedy the evils now existing? A commission has been appointed by the Academy consisting of the following: Prof. Charles S. Sargent, Chairman; Prof. Alexander Agassiz, Gen. Henry L. Abbott, Prof. William H. Brewer, Mr. Arnold Hague and Mr. Gifford Pinchot.

At a meeting of the Board of Managers of the New York Botanical Garden on March 4th plans were considered for a museum building and sketches for greenhouses were exhibited. The Secretary was instructed to exhibit topographical maps of the garden site at the annual reception of the New York Academy of Sciences, on March 26th.

The United States Senate has passed the agricultural appropriation bill carrying appropriations amounting to $3,262,652.

As previously announced Sir Joseph Lister will preside over the Liverpool meeting of the British Association. The presidents of the sections will be as follows: Mathematics and Physics, Prof. J. J. Thomson; Chemistry, Dr. Ludwig Mond; Geology, Mr. John Edward Marr; Zoölogy, Prof. E. B. Poulton; Geography, Major Leonard Darwin; Economics, Right Hon. Leonard Courtney; Mechanical Science, Sir Charles Douglas Fox; Anthropology, Mr. Arthur Evans; Physiology and Pathology, Dr. Walter Holbrook Gaskell; Botany, Dr. D. H. Scott.

An Anthropological Club for informal discussion was formed in New York on March 4th. Some fifteen students of anthropology met at the house of Dr. Franz Boas and discussed the recent works on children and child psychology by Sully, Baldwin and Chamberlain, the books being reported on by Prof. Giddings, Dr. Farrand and Dr. Boas, respectively. Meetings will be held monthly, but no formal organization is proposed.

Arrangements have, however, been made for the more formal recognition of the mental and social sciences by the formation of a section of the New York Academy of Sciences devoted to anthropology, psychology and philology. Several members of the Academy were engaged in the study of these sciences, and a number of new members have been elected and nominated with a view to the organization of this section. The Academy now meets in three sections—Astronomy and Physics, Biology, and Geology and Mineralogy—which take up the evenings of the first three Mondays of the month. The fourth Monday will be alloted to the new section. At the first meeting, which will be on April 27th, papers will be presented by Drs. Giddings, Cattell, Farrand and Boas. For the May meetings a philological program will be arranged.

THE annual exhibition and reception of the New York Academy of Sciences will be held on the evening of March 26th at the American Museum of Natural History. The two exhibitions that have preceded have been very successful both from a scientific and from a social point of view, and the program and arrangements of the present meeting promise an even more notable success. Many of the exhibits, representing the progress of science during the past year, are sent from places outside New York, and members of scientific societies in other cities will be welcomed at the reception. Invitations may be obtained from the chairman of the executive committee, Prof. H. F. Osborn, Columbia University.

PRESIDENT CLEVELAND has been invited to formally open the International Commercial Museum at Philadelphia in the autumn.

THE *British Medical Journal* states that in the course of a communication to the Paris Société de Biologie on Feb. 22d, M. Chantemesse said that last June he had succeeded in immunising several horses against the virus of typhoid fever. He had obtained the serum of such strength, that one-fifth of a drop inoculated into a guinea-pig twenty-fours before infection protected it against a dose of typhoid virus fatal to animals not previously injected with the protective serum. It was ascertained, also, that injections of the serum produced no injurious effects upon a healthy man. M. Chantemesse stated that he had since employed injections of serum in three cases of typhoid fever. The temperature showed a regular fall from the time the first injection was made, and seven days after the commencement of the injections all three patients were quite free from fever, and had commenced to convalesce. M. Chantemesse added that the cases were not yet sufficiently numerous to permit any trustworthy conclusion to be drawn.

AT a meeting of the board of managers of the National Geographic Society, on March 6th, Mr. Grip, the minister of Sweden and Norway, asked the Society's assistance in distributing among the inhabitants of arctic America sketches of the balloon to be used by Mr. Andrée, and explanations in native languages in order "to prepare the populations of those northern tracts for the possible appearance at their places of the balloon and its occupants, partly in order that they may report the balloon if they should see it at a distance, and partly to prevent them from doing any harm to its occupants when they descend unexpectedly."

MR. W. J. L. WHARTON states in *Nature* that Captain Balfour, of H. M. S. *Penguin*, has obtained three soundings of over 5,000 fathoms, the deepest being 5,155 fathoms. The positions of the soundings are :

Lat. S.	Long. W.	Depth. Fms.	Depth. Feet.	Nature of bottom.
23° 39′	175.04	5022	30,132	(Wire broke.)
28° 44′	176.04	5147	30,882	Red clay.
30° 28′	176.39	5155	30,930	Red clay.

The extreme soundings are 450 miles apart, and are separated by areas of considerably less water. The deepest trustworthy sounding heretofore known is 4655 fathoms near Japan, obtained by U. S. S. *Tuscarora* in 1874.

MR. ROY W. SQUIRES goes to Venezuela as a representative of the department of botany of the University of Minnesota and under the auspices of the Orinoco Company. He will make collections in the unexplored mountain regions southeast of Barancas. The region covered will lie considerably south of that visited by previous botanists and a valuable collection may be looked for. Mr. Squires will be absent from Minnesota about six months.

WE regret to learn that Dr. Herbert Haviland Field is seriously ill at Zurich and is at present prevented from attending to his work in the

Bibliographical Bureau. A temporary substitute has been engaged but the progress of the bibliography will be seriously impaired. It is especially unfortunate that Dr. Field (having after his prolonged efforts successfully established the Bureau) should now be incapacitated. The future of the Bureau seems to depend mainly upon his efforts, and all who are interested in his work hope to hear of his rapid recovery.

ARNULF SCHERTEL describes, in the last *Berichte*, a new method of preparing Platinocyanids. Platinum chlorid is precipitated by hydrogen sulfid at 60° to 70° and the well washed platinum sulfid dissolved in a warm solution of potassium cyanid. On evaporation the potassium platino-cyanid, $K_2Pt(CN)_4, 3H_2O$, crystallizes out, and equal parts of potassium sulfid and potassium thiocyanate remain in the mother liquor. If a solution of barium cyanid is used, the barium platino-cyanid is obtained, with commercial potassium cyanid containing large quantities of sodium cyanid, Schertel obtained the beautiful double salt $KNaPt(CN)_4, 3H_2O$, described by Martius. In view of the fluorescence of the barium and other salts of the platino-cyanids under the Röntgen rays, this simple method of preparation is of considerable interest.

IN 1888 crania of *Sorex personatus* and *Synaptomys cooperi* were taken about eight miles from Washington, in pellets ejected by a long-eared owl. This was of interest, since it was the first occurrence of *Synaptomys* farther east than Indiana, but it was of course an open question as to just how near Washington the specimen might have been captured, and, until recently, all attempts to take either of these little mammals near the capital have been fruitless. On January 25th Mr. Vernon Bailey read a paper before the Biological Society on Tamarack Swamps as Boreal Islands in which he took the ground that the abundant sphagnum of these swamps played a very practical part in reducing the temperature by evaporation, and thus rendering them habitable for boreal animals. In the discussion which followed the paper Mr. Bailey was apprised of the existence of such swamps near Washington, and immediately proceeded to test his theory by setting a number of traps in one of them, with the result that in less than a week he obtained examples of both *Sorex personatus* and *Synaptomys cooperi*.

THE extensive mycological herbarium of Mr. J. B. Ellis, of Newfield, New Jersey, has been purchased by the Board of Managers of the New York Botanical Garden, and will be deposited in the fire-proof museum building of the Garden to be erected in Bronx Park. The purchase includes a considerable portion of Mr. Ellis' library. The collection is now being boxed for transportation and will be brought to New York within a short time and placed in one of the fire-proof storage warehouses, awaiting its final resting place at the Garden. The herbarium represents the work of nearly fifty years devotedly given by Mr. and Mrs. Ellis to the study and accumulation of Fungi from all parts of the world. It is especially rich in North American species, being, indeed, very nearly complete in that regard, and containing all or very nearly all the types described either by Mr. Ellis alone, or in coöperation with Dr. H. C. Cooke, Mr. B. M. Everhart, Mr. E. W. Martin, Prof. W. A. Kellerman, Rev. A. B. Langlois, Mr. E. D. Holway, Mr. B. L. Galloway and others. It is put up in volumes, there being some 250 volumes of published exsiccati, including all but a very few of the earliest distributed sets and more than 150 volumes of a general collection, the whole completely indexed on a card catalogue. There are also more than 100 tin cans and boxes filled with fleshy fungi. The possession of this important collection will make the new botanical institution a center of interest for all students of these plants, and, with the other herbaria already secured, will guarantee its scientific prestige.

CORNELL University has formally acquired the famous quadruple-expansion steam engine, built for a steam pressure of five hundred pounds, in the Sibley College shops, by Messrs. Hall and Treat. This engine was designed in accordance with the principles taught its builders, in Sibley College, and for a very exceptionally high steam pressure; the purpose being to ascertain whether the promised advantages of such intense pressures could be realized. The University gave the use of shops and tools and such material as could be supplied without serious cost, and the makers furnished time and labor, and, at their own cost, put in the boiler, an extraordinary construction built for specially high pressures and actually tested to 1300 pounds per square inch. The engine and boiler will hereafter constitute an important portion of the Sibley College equipment, and is expected to do wonderful work. It is already known to be capable of excelling the world's record in economy, on saturated steam; although that record is at present held by a triple-expansion engine of thirty times the size of the Sibley College quadruple expansion engine. A series of trials has been conducted by the builders and the results will be published later as a thesis, by the builders, both of whom are graduate students, candidates for advanced degrees. Meantime, it is known that the engine has developed twenty horse-power, its rated work, on a consumption of less than ten pounds of steam, less than 11,000 *B. T. U.* per horse-power per hour. The College will supplement this work by still more elaborate trials, and in the expectation of still further reducing the figure. Mr. Hall, the senior of the designers and builders, has been, for some years past, the stroke oar of the Cornell ''Varsity' crew.

THE annual general meeting of the Institution of Mechanical Engineers was held at London on January 30. The report of the council stated that at the end of last year the number of names in all classes on the roll of the institution was 2,270, as compared with 2,222 at the end of the previous year. The council had bought a site at Storey's gate, Westminster, with the view of providing a permanent home for the institution. Contracts are being prepared for a building, and it was hoped that next year the house would be completed. Amongst other technical matters which had been dealt with by the council during the year, the report mentioned a memorial to the President of the Local Government Board for the repeal of existing statutes so far as they prevented mechanical locomotion on common roads, apart from traction engines. Should the appeal prove successful the council were sanguine enough to anticipate with confidence the speedy development of a branch of mechanical engineering, which might even call forth an amount of enterprise exceeding anything that had yet arisen in connection with the remarkably rapid growth of the cycle manufacture.

ATTENTION may be called to the fact that the Academy of Natural Sciences of Philadelphia holds in trust the sum of $2,500, given by Mrs. Emma W. Hayden for a Hayden Memorial Geological Fund, in commemoration of her husband, the late Prof. Ferdinand V. Hayden, M. D., LL. D. According to the terms of the trust, a bronze medal and the balance of the interest arising from the fund are to be awarded annually for the best publication, exploration, discovery or research in the sciences of geology and paleontology, or in such particular branches thereof as may be designated. The award and all matters connected therewith are to be determined by a committee to be selected in an appropriate manner by the Academy. The recognition is not confined to American naturalists.

UNIVERSITY AND EDUCATIONAL NEWS.

THE suit of the United States against the executrix of the late Senator Stanford, for over $15,000,000, has been decided by the Supreme Court of the United States in favor of Mrs. Stanford. The future endowment of Stanford University depended on this decision.

THE will of the late Hart A. Massey, of Toronto, leaves about $650,000 to educational and charitable institutions, including the following bequests: Victoria College, Toronto, $200,000; Wesley College, Winnipeg, Man., $100,000; Mount Allison College, Slackville, N. B., $100,000; Wesleyan Theological College, Montreal, $50,000; American University, Washington, D. C., $50,000.

THE finance committee of the Senate of the State of Virginia has presented a bill appropriating $50,000 annually, instead of $40,000 as heretofore, to the University of Virginia.

THERE has been organized at Indianapolis a University of Indianapolis consisting of Butler College, the Medical College of Indiana, the Indiana Dental College and the Indiana Law School. These institutions have at present about 1000 students.

The will of the late Charles L. Colby, of New York, bequeaths $20,000 to Brown University.

Morris M. White and Francis T. White have given Earlham College, a Quaker institution in Richmond, Ind., $25,000, to be added to the endowment fund and to be known as the John T. White memorial fund, in honor of their father.

Mrs. Josiah Fiske, of New York city, has given $5,000 to Radcliffe College in memory of her late husband. The College has also received $6,568, the balance of a bequest by the late Caroline B. Perkins.

Mr. T. E. Bondurant, of De Land, Ill., has offered to give $20,000 to the endowment fund of Eureka College, Illinois, provided the Board of Trustees will secure $100,000 additional by the first of March, 1897. Mr. T. J. Underwood, of Sangamon County, Ill., has donated $10,000 towards the fund.

Prof. G. F. Atkinson has been made full professor and head of the department of botany at Cornell University, succeeding Prof. Prentiss, who has held this position since the organization of the University.

Dr. E. B. Delabarre, professor of psychology at Brown University, has been appointed director of the psychological laboratory at Harvard University during the absence of Prof. Münsterberg. Dr. Mark Wenley, recently Examiner in Philosophy to the University of Glasgow, and Lecturer at the Queen Margaret College, has been appointed Professor of Philosophy in the University of Michigan.

The committee of fifty-one, in charge of the project for the removal of Union College to Albany, at a meeting in that city on February 26th, decided to present to the Legislature a bill calling for the bonding of the city for $1,000,000 for the purpose.

A public meeting on behalf of the University College of Wales was held in Cardiff, on February 5th, under the presidency of Lord Windsor, with a view to raise £20,000 required to meet conditional grants from the Treasury and the Drapers' Company in aid of the building fund of the college. Subscriptions amounting to £13,400 were promised, including one of £2,500 from Lord Windsor.

At a meeting of the Senate of the University of London, on February 19th, Sir Henry Roscoe was elected Vice-Chancellor of the University, in the room on the late Sir Julian Goldsmid.

At a meeting of the Convocation of Oxford University the proposal to allow women to take degrees was rejected by a vote of 215 to 140. A similar proposal will soon be voted on at Cambridge, where the movement to admit women to degrees is probably stronger than at Oxford.

DISCUSSION AND CORRESPONDENCE.

CHUAR, HEGEL AND SPENCER.

It is with much hesitation that one undertakes to criticise or even comment upon a paper written in the style of that by Major Powell which appeared in Science on February 21st. The author speaks with such authority regarding the nature of matter and mind, and rebukes so firmly the philosopher and the metaphysician, that one shrinks from indicating even by a question that one may be numbered with such, or, at least, found in the class of their admirers. No one likes to confess that he is the subject of 'feverish dreams;' or write himself down as a 'wrapt dreamer' who 'imagines that he dwells in a realm above science—in a world which, as he thinks, absorbs truth as the ocean the shower, and transforms it into a flood of philosophy' (p. 271). It must be to any conscientious man a matter of sincere regret that he has cast over some unoffending physicist 'the spell of metaphysics,' and made him turn from that useful tool the spectroscope with the despairing exclamation that 'all his researches may be dealing with phantasms!' I cannot, of course, speak for Chuar, who, as a savage, has a right to be shameless, but I cannot but think that both the shade of Hegel and the living Spencer would be loth to confess themselves 'immersed in thaumaturgy,' and lovers of the wonderful, who, 'in the revelry developed by the hashish of mystery' find 'the pure water of truth' insipid (p. 269).

Nevertheless, as one who has spent several years in studying the works of the philosophers, and as one willing to pocket his pride for the sake of extending his knowledge, I feel impelled to confess that there are many things in Major Powell's paper which are not clear to me. The fault is doubtless mine, since the paper is an exposition of 'the true and simple,' loved by the spirit of sanity extant among mankind 'in the grand aggregate' (p. 269). I can touch upon but one or two of the points which perplex me.

Those of us who busy ourselves with the history of philosophy are accustomed to believe that there are philosophers of many kinds, some of whom believe in 'substratum' *et id omne genus*, and some of whom hold such things in derision. Had not the author set himself over against philosophers in general as the champion of sanity, I should have been inclined to class him among them and describe him as a Positivist of a somewhat naïve sort. Did not Comte confine human knowledge within the limits of the phenomenal? Did he not reduce cause and effect to antecedent and consequent? Was he not the avowed enemy of all 'reification?' Did not Berkeley and Hume and Mill handle without gloves the notion of 'substratum' here attributed to philosophers generally? One seems to be listening to an old, old story; and yet there must be some mistake, for all these men are everywhere allowed to pass unchallenged as philosophers, and so must have been addicted to something stronger than 'the pure water of truth.' As to the classification of Hegel with Chuar and Spencer, those who think they understand Hegel (and there are such) stoutly maintain that he did not believe in 'substratum,' and that it was in throwing away the remnant of it left by Kant that he has earned the gratitude of posterity. It is, of course, possible that Major Powell has made a more careful study of his works than they, and has discovered a real similarity between his doctrine and that of Spencer.

The passages which dwell upon the constitution of matter occasion me no less perplexity. "All matter has four factors or constituents, number, extension, motion and duration, and some matter at least has a fifth factor, namely judgment" (p. 265). To one not habituated to 'the true and simple,' this seems at first glance 'reification' of the worst sort.

These 'entities' (I use the word for want of a better) are made factors or constituents of matter. The first four, of which alone I wish to speak just now, are not commonly regarded as of such a nature that when put together they can make a thing. The Pythagoreans have been criticised for 'reifying' number in making it the principle of all things. Descartes has been criticised for treating extension in much the same way. Major Powell goes further and 'reifies'—what other word can one use?—motion and duration. Why he left out impenetrability it is hard to say, but that may be explicable as an oversight, for the article bears the marks of having been hastily written. Why he chose motion and duration, I cannot conceive. Can we think of these as constituents of matter?—as constituents of the ultimate chemical particle to which he refers (pp. 265 and 270)? Some of the philosophers who object to the reification of things define motion as the change of spatial relations between material objects. If such be motion, it is difficult to think of motion as a constituent of an atom. If motion be something else, it would be interesting to have it defined. Is all its motion present to an atom at a single instant as all its extension is? Or can an atom at a single instant be said to have motion at all? I almost slipped into saying 'be *in* motion at all,' but such an expression must be abandoned; the atom's motion must be, so to speak, in it. Those who are not ashamed to read the works of the philosophers will remember that this difficulty about having motion at a single instant came to the surface something more than two thousand years ago. And if the motion in question is merely a factor of the atom, a constituent, is it not fair to suppose that an atom may have motion without changing its place at all? What have external relations to do with the existence of the constituents of this particular atom?

As to duration. Here the difficulty is as great. Can an atom have its duration all at once? Must it not take it bit by bit as it comes to it? Then the duration which helps to constitute the atom must at each instant be different from that which plays its part as factor at the next. A further difficulty rises with the thought that, perhaps, after all, duration cannot have its being in a single instant, but needs at least two to be duration. The atom at any instant is just what it is, and is made what it is at that instant by the presence of all its four constituents. If duration needs more than one instant to be duration, how can it be present at a single instant? That duration really implies more than a single instant seems clear from the fact that "in the material world we have no knowledge of something——which has not duration as persistence or duration with persistence and change" (pp. 270–271). Surely a thing cannot persist all in an instant any more than a bird can flock all by itself, or one man look alike. There are philosophers 'lost in the meaning of words, forever wandering in linguistic jungles' (p. 266), who have maintained that duration is nothing but a name for a certain kind of order in things, the order we call successive. Such philosophers, 'in the revelry developed by the hashish of mystery,' protest against the reification of duration, and even so far forget themselves as to denounce the tendency to reify it as a lapse into mediævalism. Making it a constituent of matter they regard as reifying it, and they are capable of interrupting a man at a spectroscope with the diabolical suggestion that they would as lief reify the relations 'greater' or 'smaller,' as the philosopher did when philosophy was in its infancy.

Regarding the fifth factor, which serves as a constituent of some matter—'judgment'—Major Powell's expositions do not appear to me luminous. Many views have been held as to the relations of mind and body, and even philosophers have not been at one as to the particular sort of mystery in which they would decide to revel in discussing this problem. Most of them now speak with some hesitation upon the subject, and confess that the problem is difficult of solution. To Major Powell it is as clear as noon-day. There is matter which consists of number, extension, motion and duration, and there is other matter which consists of these with the addition of judgment. But bodies consist of ultimate particles. In describing in what these ultimate particles resemble each other and in what they differ, the author seems to have overlooked this fifth factor, which is to differentiate some particles from others (p. 265). This must be an oversight, for are not the two classes clearly distinguished as different in the number of their constituents? And are we not informed that the constituents 'are never dissociated, but constitute matter' (p. 265). The chemist has then to reckon with chemical particles which have judgment and those which have not. Presumably more or less of the former are found in the human brain, and the chemist of our day should not overlook them. We have here a new kind of atom, more complex in its nature than other atoms, and gifted with a constituent of a very remarkable sort. Since the five constituents are never dissociated, we may expect to find such atoms also in other situations, where the common man never thinks of looking for judgment. And this fifth constituent has the peculiar faculty of developing 'into cognition of the constituents of matter, of their relations, and also a cognition of cognitions and the relations of cognitions' (p. 268). Notwithstanding this surprising development, it presumably still remains a constituent of the atom. Since brains consist of nothing but atoms, and nonentities must not be reified, this factor, to be real at all, must be a constituent of individual atoms. And since the atoms in brains keep coming and going, the careful observer may reasonably hope to find such atoms everywhere, with their fifth factors developed into a 'cognition of connitions and the relations of cognitions.' It is gratifying to one who finds all this obscure to be told that "science does not lead to mystery but to knowledge, and the mind rests satisfied with the knowledge thus gained when the analysis is complete." We are quite willing to take the author's word for the fact that it is here complete, but we must confess with humility that we walk by faith.

Having nerved ourselves to the effort of accepting the two kinds of matter as a refuge from mystery, we feel a mild wonder at certain sentences which seem to indicate that there are, after all, two worlds and not one. "Concepts of number, extension, motion, duration and judgment are," we are informed, "developed by all minds, from that of the lowest animal to that of the highest human genius" (p. 269). What is this mind, of which the author speaks? And what is meant later by the author's division of reality into 'the material world' and 'the mental world' (p. 271), or 'the material world' and 'the spiritual world' (ibid). If we are dealing with indissociable constituents of matter, would it not be as wise to speak of 'the material world' and 'the world of duration,' or 'the material world' and 'the world of motion?' But I waive these questions, as being possibly the products of a 'feverish dream.' It must be accepted as a general answer to all such, and a sufficient consolation to the discontented, that 'the simple and the true remain' (p. 271).

As a last word I may add that the more sober of the philosophers of our time have, notwithstanding 'the intoxication of illusion,' been accustomed to think that it is not prudent for a philosopher who has no special knowledge of the subject to venture into other fields, as, for example, that of anthropology. Some even go so far as to believe that it is not wise for an anthropologist to venture into philosophical discussions unless he has acquainted himself with the writings of those who have preceded him in work of that kind. Perhaps it is because they are 'immersed in thaumaturgy' that they find in such contributions to philosophical literature more heat than light.

GEORGE STUART FULLERTON.

UNIVERSITY OF PENNSYLVANIA, February 27, 1896.

THE TEMPERATURE OF THE EARTH'S CRUST.

IN the December number of the *Journal of Science* Prof. Alexander Agassiz gives the temperatures found at different depths in a well-known mine in the Lake Superior region, as follows:

At 105 ft.—59° F.
At 4580 ft.—79° F.

Or an increase of temperature of 1° F. for each 223.7 ft.

With this he compares Lord Kelvin's figures of 1° in every 51 ft; also the figures obtained in the St. Gothard tunnel, showing a rise of 1° for every 50 ft.

The Lake Superior figures would make the solid crust of the earth nearly 90 miles in thickness, instead of Lord Kelvin's deduction of twenty miles.

Now I wish to suggest, as a tenable hypothesis, that the Lake Superior district having been far in the heart of the ice cap of the glacial period, the refrigeration of the crust of the earth penetrated to so great a depth that its effects *still linger*.

Take, for example, the 100° C. line, which normally is 9,000 feet below the surface. During the many thousand years of the ice cap this may have been forced downwards to a depth of, say, 40,000 ft. Since the removal of the ice, during, say, 7,000 years, the internal heat has been slowly rising towards the surface. But it has not yet had time to regain its former levels of temperature.

It would be interesting to ascertain what are the rates of increase of temperature now under regions where the subsoil is permanently frozen, as in the tundras of Siberia and Alaska.

It does not seem clear to me that the earth's crust necessarily became greatly thickened in the Superior region. The refrigeration need not have penetrated deeply enough for such an effect.

SERENO E. BISHOP.

HONOLULU, January 24, 1896.

THE X-RAYS.

SHORTLY after mailing my note of last week I took a photograph by means of the X-rays, using a Crookes' tube connected with an induction coil actuated by a make and break current, and therefore giving the electrodes a fixed polarity.

The photograph shows only one electrode which, from the manner in which the tube was connected, was the cathode, thus confirming the views expressed in my previous letter.

RALPH R. LAWRENCE.

BOSTON, March 5, 1896.

THE INSTINCT OF PECKING.

IN discussing Prof. Morgan's lecture on instinct it has several times been stated that chickens pecked instinctively, but had to be taught to drink. There was a note in *Nature* last year, concerning some species of Asiatic pheasants—it may possibly have been the Jungle Fowl—to the effect that the young did not peck instinctively and did not offer to take food spread before them. The natives seemed well aware of this peculiarity, and in the particular instance recorded a native induced the young birds to peck by tapping on the ground with a pencil near the food. They seemed attracted by the sound and movement, and were thus induced to peck at the food. F. A. LUCAS.

SCIENTIFIC LITERATURE.

BRONGNIART'S PALEOZOIC INSECTS.

Recherches pour servir a l'histoire des Insectes fossilesdes temps primaires, précédées d'une étude sur la nervation des ailes des Insectes. Saint Etienne, 1893. 2 v. 4°. Text, 493 pp.; Atlas, 44 pp., 37 folding plates.

These volumes, which are primarily devoted to the carboniferous insects of Commentry, France, form the most important work that has ever been published on paleozoic insects. Our knowledge of the older hexapods has heretofore been obtained piecemeal, and generally by exceedingly fragmentary researches; while here we are introduced at once to a wealth of material equalling, if it does not surpass, all previous knowledge of paleozoic insects. Mr. Brongniart had indeed published a few of his interesting finds in previous minor papers and had given also a summary account of the Commentry fauna in a brochure in 1885; but as the latter contained almost no details, and was merely a sketch of his classification (here modified in a few particulars), it had slight value except as a forecast of what is now realized.

Cockroaches form in all Carboniferous deposits the major part of the insect remains, and many hundreds of specimens have been obtained at Commentry. Leaving these out of account because reserved by the author for future publication (a few figures only without descriptions being given), the fauna of Commentry consists, according to Brongniart, of Neuroptera, Orthoptera and Homoptera; these he divides into 12 families or larger groups, ten of which are regarded as extinct, and they include 48 genera and 97 species, a number of species just about double that of the previously known European Carboniferous hexapods, exclusive of course of cockroaches.

The variety, novelty and striking character of the forms revealed is as interesting as their number. No one of them, indeed, can be regarded as extraordinary as Eugereon; but we are introduced to long-winged giants regarded by Brongniart as the precursors of the Odonata, but which in spread of wings make our largest dragon-flies appear as pigmies; one, Meganeura, has a spread of considerably more than two feet, and one specimen of this, which I have had the good fortune to see, is so well preserved that four nearly perfect and fully expanded wings are in place attached to the thorax; others have saltatorial hind legs as fully developed as in our existing Locustarians, but with very different wing neuration. Thyspanura (before known fossil only from the Tertiary) are indicated—unfortunately not figured—which have but a single caudal seta; more than fifty specimens of this have been unearthed. Insects are found with a broad lobate expansion on either side of the prothorax, recalling some living Mantidæ (Chœradodis, etc.), but which, being filled with apparent nervures, Brongniart regards with too great confidence as prothoracic wings. Others, and these include a variety of types, have lobate appendages at the sides of all the abdominal segments, like the branchial gills of the larvae of some existing Neuroptera, persistent through life in Pteronarcys. There are also gigantic Mayflies, and Neuroptera of large size with caudal setæ more than six inches long. And, finally, we may mention undoubted cockroaches which show a straight, slender, Locustarian-like ovipositor half as long as the abdomen, an additional and striking difference to distinguish them from modern cockroaches.

Brongniart begins his work with a somewhat detailed historical review of discoveries in the field of paleozoic insects, with an appended bibliography, and follows it by an extended study of the neuration of existing Neuroptera, Orthoptera and Fulgoridæ (180 pp.), as a basis for his attempt to classify the Carboniferous forms; 12 of the plates are also given to the illustration of the wings of modern insects. In this study he follows with some modifications the guidance of Redtenbacher, apparently unaware of some later studies on the subject, and the descriptions are almost entirely independent of each other without definite comparisons.

The third part of the work (184 pp.) is given to his subject proper; it is somewhat unequal in character, being much more detailed and careful in the earlier portion than in the later. Here, too, one looks in vain for comparisons or for any definite reasons for the inclusion of some of the insects in the groups in which they are placed, by references to the earlier portion of his work. The classification is entirely novel and bears little relation to that employed by the present writer, which is an extension of that of Dohrn and Goldenberg. This is not the place for a discussion of the relative merits of the two, which may be left to the impartial student of the future; but in giving up the term Palæodictyoptera for the bulk of paleozoic insects, as indicating the far greater affiliation of insects in paleozoic time than subsequently, Brongniart overlooks the fact that while his discoveries show a wider diversity of forms among paleozoic insects and more definite points of relationship between them and and later types than we have ever had before, they but emphasize and further illustrate the reasons for which the name was proposed. General statements previously made regarding paleozoic insects as a whole are in no way weakened by this great extension of the field, and this renders the importance of these generalizations even greater and their validity surer than before.

The work is most luxuriously issued and the plates all that could be desired, excepting that many of those illustrated by heliogravure (in the most artistic manner, indeed) need to be supplemented by drawings showing the precise origin of each of the veins; these are often obscure in the best photographic picture, since they very often cannot all be seen in any single view, or their contrast to the stone is insufficient for clear results. Why the title page should bear the date 1893 is difficult to understand, for the second signature (p. 12) contains a long extract first published in America in February, 1894, and the earliest copies of the work only reached this country in June, 1895. Except in the separate 'Explanation of the Plates' in the atlas, no reference to the figures occurs in the text, which is a great inconvenience.

SAMUEL H. SCUDDER.

Revision of the Shrews of the American Genera Blarina and Notiosorex. By C. HART MERRIAM, N. Am. Fauna, No. 10, December 31, 1895, pp. 5–34, pll. 1–3.

The Long-tailed Shrews of the Eastern United States. By GERRIT S. MILLER, JR. Ibid., pp. 35–56.

Synopsis of the American Shrews of the Genus Sorex. By C. HART MERRIAM. Ibid., pp. 57–98, pll. 4–12.

The shrews are among the most difficult of mammals to discriminate specifically, owing to their general similarity in color, size and general external appearance. Hence resort must be had to the teeth, which, though minute, often afford trenchant characters. No group of American mammals has hitherto been in a more thoroughly unsatisfactory state, as regards either the number and distribution of the species or the names they should properly bear. Hence the three papers on the American Shrews that constitute No. 10 of 'North American Fauna' are a particularly welcome contribution to the literature of North American mammalogy. Two of these papers are by Dr. C. Hart Merriam and the other is by Gerrit S. Miller, Jr., and jointly they comprise a careful revision of the whole group. The work is based primarily on the collections brought together by Dr. Merriam under the auspices of the United States Department of Agriculture, the only outside material used being mainly the type specimens of previous authors, which in most cases have been accessible to the authors of the papers under notice.

Formerly shrews were rare in collections; generally they were so difficult to obtain that only chance specimens were secured. That such is no longer the case is evident from the large number of specimens now accessible for study in most large collections of mammals, very successful methods of trapping these obscure and mainly nocturnal animals having been discovered within comparatively recent years. Thus the Department of Agriculture collection alone numbers upwards of 2,000 specimens, brought together largely within the last six or eight years.

The North American species of shrews fall rather naturally into two principal groups, which in popular language are known as the short-tailed shrews and the long-tailed-shrews. The former, comprising the genera *Blarina* and *Notiosorex*, are strictly North American; the latter, referable to *Sorex* proper (with, however, several subgenera), belong to a genus widely dispersed over the northern hemisphere. Of the short-tailed shrews, the genus *Notiosorex* comprises, as now known, only a single species, with a range from near the southern border of the United States southward over a large part of Mexico; *Blarina* has a much wider distribution, ranging, in eastern North America, from about the southern border of Canada southward through Mexico to the mountains of Guatemala and Costa Rica, but in the United States is mainly restricted to the region east to the Great Plains. It is divisible into two subgenera—*Blarina* proper, and *Cryptotis*, chiefly in reference to the number of the teeth, which are 32 in the former and 30 in the latter. In general the species of *Blarina* are much the larger, and are more northern in distribution, this group being 'absolutely restricted to the United States,' all of the Mexican and Central American species belonging to the subgenus *Cryptotis*, which in turn is almost unrepresented north of the Carolinian Fauna.

It is a singular fact in the history of the genus *Blarina* that a representative of both of its sections was made known by Say in 1823, from the same locality, namely, from Engineer Cantonment, near the present site of Omaha, Nebraska, and that they were the first forms of the group made known to science. Say named them respectively *Sorex brevicaudus* and *Sorex parvus*. The latter name especially has ever since been a stumbling block in the way of systematists, but, thanks to Dr. Merriam, is so no longer, his large series from the type locality enabling him to define it and establish its relations to the various names given later to shrews from other parts of the country. It thus proves to antedate *cinereus* of Bachman, while several species provisionally separated from it by Baird are now referred to it as synonyms.

Blarina, according to Dr. Merriam, is represented by 20 species and subspecies, of which 6 are from the United States and 14 from Mexico and Central America; all of the latter and two of the United States forms are referred to to the subgenus *Cryptotis*, leaving only 4 for the subgenus *Blarina*. Most of the Central American and some of the Mexican species are more or less isolated mountain forms, modified from a few formerly more widely dispersed types. Of the 12 new forms here described, 9 are from Mexico, 2 from Florida and 1 from Dismal Swamp, Virginia.

Mr. Miller's paper relates to the long-tailed shrews of the eastern United States, and admirably clears the way for Dr. Merriam's immediately following general synopsis of American species of the genus *Sorex*. At the outset Mr. Miller attacks sundry vexed questions of synonymy resulting from the description of three species of this group by Dr. Richardson, nearly seventy years ago. Fortunately Richardson's types are still extant in the British Museum, and Mr. Miller has recently had, through the kindness of Mr. Oldfield Thomas, the Curator of the Department of Mammals in the British Museum, opportunity to carefully study these invaluable types. As a result Richardson's names may now be considered as properly allocated, and we can with some confidence assign names to our shrews; for until Richardson's names were settled many later names could only be applied tentatively. Mr. Miller treats at length of 7 species, 1 of which is described as new.

Dr. Merriam, in his 'Synopsis of the American Shrews of the genus Sorex,' recognizes 42 species and subspecies, of which 21, or just one-half, are described as new in the present paper. Of this number 34 are referred to *Sorex* proper, 1 to the subgenus *Microsorex*, 4 to the subgenus *Neosorex*, and 3 to the subgenus *Atophyrax*. The shrews of the subgenus *Sorex* range from the Arctic Circle southward over the continent-at-large, or such parts of it as are congenial to their peculiar needs, to the mountains of Guatemala; *Atophyrax* is restricted to the northwest coast region, ranging from western British Columbia to California; *Microsorex* and *Neosorex* occupy a middle transcontinental belt near the northern boundary of the United States, *Neosorex*, however, extending farther southward along the principal mountain ranges. The long-tailed shrews in general prefer forested or semi-wooded regions, and a rather northern or alpine habitat; they are hence not generally dispersed south of the northern parts of the United States; farther southward and in the drier portions of the continent they are limited to mountainous districts.

This admirable series of papers is illustrated by twelve plates and some additional cuts in the text giving carefully-drawn figures of the skulls and dental characters of most of the species. Fauna No. 10 thus marks an epoch in the history of this hitherto little-known and difficult group of American mammals.

J. A. A.

Indianische Sagen von der nordpacifischen Küste Amerikas. FRANZ BOAS. Berlin, A. Asher & Co. 1895. 8vo., pp. 363.

This is, undoubtedly, the most comprehensive collection of northwestern Indian myths now in existence and, considering the length of time, the hardships and privations experienced in obtaining them, and the large number of tribes that had to be visited, is a work unique of its kind. Boas had published these myths previously in the 'Transactions of the Berlin Society of Anthropology,' and this explains the fact that they are worded in German and not in English. Most of the stories that were obtained from full-blood Indians in their vernacular had to be translated into Chinook Jargon before they were rendered in German.

Dr. Boas begins with the myths, legends and traditions of the numerous Selish tribes of British Columbia, then presents what he obtained on Vancouver Island and the mainland opposite, and terminates the volume with the tales from the Haida on Queen Charlotte Islands and the Tlingit of southeastern Alaska. The stories have the most varied contents: Origin of the deities and powers ruling the universe and the earth, creation of sun, moon and stars, origin of the elements and seasons, of the tribes of men, animals and plants, of the rocks and islands. Men and women often originate from animals, especially from fish, and the number and variety of the 'fishy' progenitors is so great that no other but a fisher race could have produced a similar folklore. The making of the sun is mostly represented as a liberation of it from a box or inclosure which held it in captivity, and the liberator is the raven, who in his bold flight cuts through the dense cloudiness enveloping the ocean and the seashore or permits it to ascend again to the sky, after night had imprisoned it for a long while. The raven also provides the organisms, when lifeless still, with souls, and is regarded as the animating principle in nature. In the myths of the Eastern tribes the raven is of great significance, being the presager of calamities and death.

The most painstaking portion of Boas' work lies in the appendix from pages 329 to 363, where in a statistical essay the attempt is made to trace one and the same myth through various parts of North America. There are, *e. g.*, nineteen myths in the Northwest found similar to Micmac, eleven to Ponka, twenty-five to Athapaskan — even among the Aino of north Japan elements were discovered comparable to those of the northwest coast. To follow up all these details in Boas' volume, is of the highest interest; the number of linguistic families to which the legends belong are five in number (see Table, p. 329), Selish, Wakash (or Nutka), Tsimsián, Haida and Tlingit—the first and the second of these showing a large number of dialectic sub-divisions.

As a fair instance of the mythic imagery which forms the make-up of the northwestern religions, we may present the world's creation as related by the Tsimsián Indians on Skeena river and the coast of the mainland. They assume that the earth is level and disk-shaped, resting upon a pillar which is held upright by an old woman. Any movement of the old woman causes an earthquake, but the hillocks and sinuosities on the earth's surface were produced by a flood, which scattered all the human beings over the most distant parts of the earth to people them. Whoever wants to visit the sky has to pass through the moon's house, and its headman is called 'Disease.' The west side of the moon's house is guarded by a number of mischievous dwarfs, who are hermaphrodites and likely to attack and kill visitors. When Gamdigyētlnē-eq started to reach the sky, his friends tried to dissuade him from making the attempt. He told them, "When I get up there you will see that the sun is stopping in its course." He shot an arrow into the blue sky, saw it fly and it stuck fast in the firmament. Another arrow he sent into the notch of the first, another one into the notch of the second and thus was formed a long chain of arrows solid enough for him to climb up. His bow served him to fill a gap in the aërial road. Reaching the moon's house, he was not molested by the dwarfs, but well received by the chief of the moon's dwelling, who washed and cleaned him thoroughly and gave him moral advice what to do after his return to the earth. A board was then removed and Gamdigyētlnē-eq could see the whole earth extended below him as a cyclorama, he then descended again on the arrow-ladder, which fell to pieces after the descent was accomplished and the upholding bow removed from the base.

Boas' book forms an interesting parallel to his 'Chinook Texts' previously reviewed in SCIENCE, but differs from it by the absence of aboriginal Indian texts.

Names and their Histories, alphabetically arranged as a handbook of historical geography and topographical nomenclature. By ISAAC TAYLOR, M. A., Canon of York. London, Rovington, Percival & Co., 34 King St. 1896. pp. 392. 12mo.

To collect the geographic terms which serve to compose a country's local names, and then follow these terms through their compounds as we find them used in the toponymy of a given country, is a method not often followed as yet. Isaac Taylor, M. A., in his '*Names and their Histories*,' has given full swing to this synthetic method in the appendices, and, we must say, with laudable industry and good success. He presents his interesting information not in the form of dry sentences and axiomatic paragraphs, but in the didactic shape of lectures, which do not show any purpose of cramming the listener's brain with erudition and quotations derived from documents one thousand years old. Taylor's easy, unobtrusive prose conveys to the public only what is necessary to know, by giving the earlier historic forms of the local names and from them deducting their signification. The treatise on nomenclature is subdivided in seven chapters, pages 303 to 390, and contains the following items: Indian nomenclature (of East India), Turkish nomenclature, Magyar names, Slavonic nomenclature, French village names, German nomenclature, English village names.

When the student of geography has passed through these propædeutics and become acquainted with the elements of topography in every group of dialects, he finds it many times easier than before to retain so many foreign appellations, often unwieldy and jaw-breaking, because their meaning is now familiar to him. Of the Turkish names the majority are of a vocalic utterance and well sounding, a great help to memory. Thus Buyuk-dere is the 'great valley;' Tash-bunar, the 'stone-well; Bunar-bashi, the 'head of the well' (or 'spring'); Kara Dagh, the 'black mountain;' Mustagh, the 'ice mountain;' Daghestan, the 'mountainous land;' Kara-kum, 'black sand;' Yildiz, the 'northern' (palace); Yeni-bazar, the 'new market.' The names of the seven territories have been studied for many years back by linguists, and Taylor having made use of the writings of his predecessors, can be relied on.

The first part of the volume gives in 302 pages a large number of geographic names from all parts of the globe in alphabetic sequence, each with its historic and linguistic illustrations. Here also Taylor strives to be on a level with the popular understanding and avoids long arguments, wherever these would lead him into dry erudition and scholarly distinctions. Many names are referred to historically, but their derivation is not given because it could not be given with safety; of others the derivation is given as 'probable' only, as of Nazareth, which is supposed to mean a 'watch-tower,' and of Cuba, said to mean 'middle province.' Of a large number the signification is certain, as Damascus 'the place of industry,' Dundas, 'southern fort,' from Gaelic dun-deas; Zimbabwe the 'great kraal,' Sligo called after 'shells found there in heaps,' Lampedusa, 'oyster bank,' Liverpool, a pool where a waterfowl, called 'liver, lever' was found. Seville is Phœnician and means 'plain, lowland,' Marsala the 'port or harbor of Ali." Among those names which Taylor has explained erroneously we notice Arkansas, Arawak and Tallahassee.

A. S. G.

The Sun. By C. A. YOUNG. New and revised edition. New York, D. Appleton & Co.

The revised and slightly enlarged edition of Prof. Young's '*Sun*' will be read by all with great interest. The first edition of this justly popular work appeared in 1881. Since that time many advances have been made in our knowledge of the sun; new methods of observation have been developed. Prof. Young tried to keep pace with this progress by the addition of notes and appendices in the various editions that have appeared during the interval. He now finds, however, that such expedients are inadequate, and he has, therefore, revised the work and made it representative of the science of to-day.

In general form and appearance the book remains the same as in the first edition. There are, however, a number of new cuts, and the various subjects, treated of in a single chapter, are more clearly separated. Many 'headlings' are introduced into the text, thus greatly aiding a clear understanding of the subject-matter.

Among the most prominent features of the new edition we note the introduction of the latest work on the solar parallax. Gill's methods and results are most carefully treated. Again the great advance in solar spectroscopy is represented by the work of Rowland; the photography of the prominence by that of Hale; the identification of helium by Ramsey. The progress made in the spectroscopic study of the sun is most readily brought out by a comparison of our present knowledge with that of 1881. In the first editions of his work, Prof. Young mentions twenty-one elements as known to exist in the sun. In all of these 860 lines had been identified. Prof. Rowland has now tried sixty elements; thirty-six of which he finds in the sun; sixteen he does not find there and the remaining eight are doubtful. Of one element alone, iron, he has identified more than 2000 lines; more than twice as many as were known in all the elements fifteen years ago.

A careful comparison of the last chapters, the summaries, of the two editions leaves us with a feeling of disappointment, of expectation unfulfilled. Our advance in the knowledge of solar physics has not been so rapid as we fondly imagined. During the last decade and a-half no new great principle, no law, has been discovered. We have improved our methods of observation; we have collected more data; but we know little more of the actual condition of the sun itself than we did in 1881. The first edition of Professor Young's book ends with a statement of the four most important and fundamental problems of solar physics which were at that time pressing for solution. Fifteen years have since elapsed and these four problems are still unsolved, are still pressing for solution.

C. L. P.

Elements of Modern Chemistry. By CHARLES ADOLPHE WURTZ. Fifth American Edition. Revised and enlarged by Wm. H. Greene, M. D., and Harry F. Keller, Ph. D. 12 mo. Pp. 788. Philadelphia, J. B. Lippincott & Co. 1895.

The appearance of the fifth revised and enlarged edition of the translation of this well-known work may be taken as evidence that many have found it useful. The writer believes, however, that a better *elementary* treatise might have been made, if the translators had followed less closely the plan of the original. The introduction is clear and satisfactory. In the next twenty-seven pages we find a discussion of the laws of definite and multiple proportions, equivalents, the laws of Gay-Lussac, Ampère and Avogadro, the atomic theory, the laws of isomorphism and specific heats, nomenclature * * * * * oxygen acids, metallic hydroxides, oxygen salts, nomenclature of non-oxygenized compounds, alloys and amalgams. The study of hydrogen and the other elements is then begun. It needs no argument to prove that this order of subjects is not elementary.

The succession of topics in the study of the compounds of carbon is also unsatisfactory. The order is the following: constitution of organic compounds, formation of hydrocarbons * * * * * monatomic radicals and polyatomic radicals, including general remarks

about diatomic alcohols, acids and ammonias.
* * * * *

The substances first studied are cyanogen, the ferrocyanides, the sulphocyanides, the cyanamides * * * * * urea and some of its compounds. Having mastered these simple subjects, the student is ready for methane and its derivatives. About one-half of the volume is given to the compounds of carbon. The facts are clearly presented, a good selection of compounds has been made, and recent work and theories receive due attention.

The same good judgment has been shownin discussing the other elements and their compounds. A more careful revision of the text would have removed some inaccurate statements. The synthesis of oxalic acid in 1868 can no longer be called recent, nor is it true, as stated on page 236, that nitrogen forms only one compound with hydrogen.

The use of such trivial names as potassa, caustic potassa, soda, gelatinous alumina and others is often exasperating and sometimes leads to incorrect statements. Soda is defined as sodium carbonate, but on page 353 we are told that soda produces, in salts of lead, a precipitate that is soluble in an excess of the reagent. With the general correctness and clearness of statement no fault can be found, and, as an elementary book of reference, this new edition should win new friends. L. B. Hall.

Principles of Metallurgy. By Arthur H. Hiorns. Macmillian & Co., New York. 1895. 12mo., 388 pp., 144 illustrations, cloth binding. Typography and paper of good quality.

It was the authors intention to prepare for those who do not have ready access to the journals of scientific and industrial societies an abridged account of the modern methods of extracting metals from their ores. An object worthy of attainment but in this instance not crowned with success.

The arrangement of the work is as follows: The physical and chemical properties of the metals and their alloys occupy the opening chapters, after which several chapters are devoted to general metallurgy, discussing furnaces, fluxes and fuels. Iron and steel occupy the greater part of the work, followed by chapters on silver, gold, lead, copper, zinc, tin, aluminum, mercury, antimony and bismuth. While each division of the subject contains much of value, the work is to be criticised from the fact that much of the greater value is omitted. By greater value is meant modern practice. There is not a chapter that could not be improved in this respect.

Metallurgy has been defined as the 'art of making money,' and consequently is an eminently practical subject. A treatise therefore should be devoted mainly to modern methods, subordinating historical descriptions and data, a plan quite the reverse of that given by Mr. Hiorns.

Metallurgical processes are of such rapid development that characteristic factors of any one time often become obsolete in a decade, and a work bearing the date of 1895 should present the methods brought up to at least within a few years. The present work quite fails in this respect also. Many errors have been perpetuated from previous works, and a number of illustrations are given of furnaces which have not been used for twenty years and more. American practice is painfully weak, and since we are the greatest individual producer of silver, gold, lead, iron, copper, zinc and mercury, this criticism is of great weight. Some glaring errors in this respect are as follows:

Under blast furnace practice for pig iron the furnaces quoted as embodying modern ideas are not water-cooled and they have exterior fore hearths. In view of the magnificent practice at the Edgar Thompson works where, two years ago a single furnace produced over six hundred tons of cast iron in twenty-four hours, the type of furnace as given by Mr. Hiorns is decidedly ancient.

Under the metallurgy of lead the shaft furnaces given are all of the old type; not one of them is water-cooled. Under zinc the English method is quoted as in use, although Dr. Percy remarked in a lecture that years ago he sought for evidence of this process, but failed to find even the ruins of the furnace foundations. Under steel the American modifications of rapid blowing and low silicon irons are entirely ignored, etc.

As an elementary treatise suitable for students of tender years this work presents the English practice in a general way with sufficient thoroughness to afford a popular understanding of the subject.

American practice is so lamentably weak that the work is of little practical value to our students. With extensive cutting and the addition of much new material it might be transformed into a work of value, but, as Kipling would say, "that is another story."

J. STRUTHERS.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 256TH MEETING, FEBRUARY 22.

C. HART MERRIAM spoke of *The American Weasels*, describing at some length the various species, their habitats and relationships.

F. E. L. Beal read a paper on *the Food of the Bluejay*, being the results of the examination of about 300 stomachs of this species collected in every month of the year and fairly representing all parts of the bird's range. The food is found to consist of animal and vegetable matter in the proportion of about one of the former to three of the latter. The animal matter is composed largely of injurious insects. The alleged habits of the jay of eating the eggs and young of other birds is only partially confirmed. Of the whole number of stomachs only two, taken in the breeding season, contained shells of eggs and one the remains of a young bird. One stomach taken in February contained the remains of a bird, and several taken at various times contained shells of eggs, apparently those of domestic fowls. The vegetable food consists principally of grain, mast and fruit. Of the first two mast is the favorite, being the most important element of the yearly diet. Corn is the favorite grain. The fruit consists for the most part of wild species.

David White discussed *the Structure and Relations of Buthograptus, Plumulina and Ptilophyton from the North American Palæozic.* After describing the structure of these genera in detail, the speaker stated that it would seem that all the forms considered may belong to one type of nonvascular, feather-like, or plumose organisms, which consist of a hollow or cellular thin-walled rachis, or axis, destitute of any central strand, forking but seldom in some species, perhaps in all, and possibly divided by transverse septa into cells, though this is not clearly shown in any individual case. To this axis are articulated by round or oval joints, two or more series of more or less elongate, very thin-walled, bladder-like sacs, which, for convenience, are called pinnules. With rare exceptions, these sacs are quite regularly arranged with respect to one another, their parallelism in the impressions giving the feathery appearance to the pinnæ. Similar relations obtain in all the species considered. The pinnules appear to have been eventually deciduous, falling away from the lower portion of the rachis. Although several of the species appear at first glance to very strongly resemble hydroids, the speaker followed Dawson and Lesquereaux in considering these organisms to be vegetable in their nature.

Sylvester D. Judd described *a Peculiar Eye of an Amphipod Crustacean, Byblis serrata.* He said that this crustacean, which belongs to the family *Gammaridæ*, has totally different eyes from *Gammarus*. This peculiar eye of *Byblis* reminds one of the vertebrate eye, for both agree in having a biconvex lens and a fluid filled space with the retina below. A section through the chief axes of the eye of *Byblis* would first show a large lens, which has been secreted in concentric shells by a thickened layer of lentigen, which is on either side continuous with the thinner hypodermis, which is gorged with scarlet pigment that envelopes the eye like a cornucopia, thus shutting out all rays that might reach the retina without first passing through the lens. Under the lentigen is a crescent-shaped humor space. Below and proximal to this space is a layer of columnar cells, which is continuous on either side with the hypodermis. This layer of cells has secreted on its outer boundary, which borders on the space, a strong cuticula. Just proximal to this layer of cells, which has secreted the cuticula, are the omatidia (which of course lack the corneal cuticula). The most distal element of an omatidium is a granular columnar body (cell product). Below and proximal to this columnar body, the remainder of the omatidium with its refractive cone and retinula is practically identical with the omatidium of *Gammarus*, minus, of course, the corneal cuticula. For in the retinula of both crustaceans there are five retinal cells with pigment, and four rhabdomeres. There are two of these peculiar crater-like eyes that project from either side of the cephalon of *Byblis serrata*.

Vernon Bailey exhibited *Two Mammals New to the Vicinity of Washington*, being *Sorex personatus* and *Synaptomys Cooperi*. In 1888 skulls of these mammals were found in pellets ejected by the Long-eared Owl, but until the capture of the specimens shown, which were taken at Hyattsville it had not been definitely proved that these species were found in the immediate vicinity.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the meeting of the Geological Society of Washington (D. C.), held on February 26, 1896, the following communications were presented:

Mr. W J McGee exhibited the geologic map of the State of New York recently printed by the United States Geological Survey in coöperation with Prof. Hall, State Geologist. He stated that the map had been in preparation for the last ten years and its preliminary draft was a compilation by Prof. Hall and himself in greater part from old data. Finding that these were very incomplete and unsatisfactory in many areas, new field work was begun and continued for several years. In the meanwhile a new base was compiled from county maps and other sources. The larger part of the field work was done by Mr. N. H. Darton, of the United States Geological Survey, who mapped the geology of nearly the entire area of the Helderberg and associated formations, the faulted area extending along the Mohawk valley and around the southern side of the Adirondacks to Lake George, the Niagara escarpment, the northern and eastern portions of the Catskill Mountains, the Oneonta region, the greater portions of Albany, Ulster, Orange and Rockland counties, and the Juratrias area of New Jersey. Dr. F. J. H. Merrill contributed data for Westchester, Putnam and New York counties, and Prof. J. F. Kemp mapped much of the region lying along the eastern side of the Adirondacks. Data for smaller areas were obtained from published or manuscript maps by Messrs. C. D. Walcott, T. N. Dale, J. H. Clarke, W. M. Davis, W. B. Dwight, Mr. Randall, Prof. Smythe and others. The map was edited by Mr. Willis Bailey.

Notes on the Geology of the Black Hills of Dakota were presented by Mr. N. H. Darton. The region was visited last autumn for a study of the outcrops of the Dakota sandstones and the associated formations, in connection with an investigation for the United States Geological Survey of the artesian waters of the Dakotas. There was first described a detailed section which had been carefully measured from the base of the Potsdam to the White River Miocene formation, along a line passing through Rapid City to the Bad Lands. The thickness of the upper Cretaceous members in this section have since been most satisfactorily verified by the deep well-boring on the Rosebud Indian Reservation. The salient features of the general stratigraphy were pointed out and the alleged unconformities in the Juratrias formations were discussed. Attention was called to a well-defined peneplain now represented by the eastern 'hog back' foothills of which the very even crest lines are at an altitude very nearly 4,000 feet above sea level for over 100 miles. Diagrams were exhibited of a very interesting laccolite west of Tilford, and the structure of the Bear Butte and Warren Peaks eruptive areas were described. Some incidental observations in the nucleal region of the hills brought to light some important details of stratigraphy of the Algonkian beds, and some examples illustrating the development of schistosity in the vicinity both of granite and younger eruptives.

Several miscellaneous specimens were shown, including cone-in-cone structure developed in Pierre clays by the pressure caused by the formation of sideritic concretions; material from sandstone disks in the Bad Lands, having vertical cleavage into thin plates with horizontally corrugated surfaces, and masses of phosphated grains from the Pierre clays, which appear to be of coprolitic character.

In the discussion which followed this paper, Mr. M. R. Campbell alluded to the close similarity between the relations of the even crest lines of the 'hog back' ranges described by Mr. Darton, and the Appalachian ridges, and endorsed the view that they are similarly the remnants of peneplains preserved by the harder rocks.

Mr. F. W. Crosby presented a paper entitled 'The Sea Mills of Cephalonia.' These mills are run by sea water which flows into fissures with considerable velocity. The origin of these fissures and the conditions which enables the sea water to sink into them below the level of the sea have been the subjects of popular speculation for many years, but they appear to have attracted but little attention among geologists. Mr. Crosby then quoted a paper by his son, Prof. W. O. Crosby, in which the mechanism of the phenomena was discussed and a hypothesis offered to account for it.

A paper on the 'Stratigraphy at Slate Springs, California,' by Mr. H. W. Fairbanks, was read by Mr. Lindgren.

W. F. MORSELL.

CHEMICAL SOCIETY OF WASHINGTON.

THE 85th regular meeting, which was also the 12th annual meeting of the Society, was held January 9, 1896. The following were elected to membership: Messrs. E. C. Wilson, E. W. Magruder and C. C. Moore. The publication of Bulletin No. 9, was announced and the following officers were elected: President, E. A. de Schweinitz; Vice-Presidents, W. D. Bigelow, W. G. Brown; Treasurer, W. P. Cutter; Secretary, A. C. Peale; additional members of the Executive Committee, Chas. E. Munroe, F. P. Dewey, V. K. Chesnut, H. N. Stokes.

The first paper read was by Dr. H. W. Wiley, on a 'Steam Jacketed Drying Oven,' and the oven was shown in actual operation. In order to surround the drying space of the oven entirely with steam, the door of the ordinary steam jacketed oven is made with double walls, and the steam from the oven conducted into it from the oven by two metal flexible tubes at the top and bottom of the door, so arranged as not to interfere with its opening. The temperature is regulated by a pressure gauge in which, when a given pressure is reached, the steam cuts off the gas by acting on a column of mercury. When steam is used the temperature can be regulated by setting the gauge to read at any position, to read from the boiling point of water up to 105°. For other higher temperatures other liquids can be used, as alcohol or amyl. alcohol, but ether cannot be safely employed on account of the danger of explosion if there is any leakage.

Dr. Wiley also read a paper on the 'Heat of Bromination in Oils.' The especial difficulty on the process of proposed by Hehner and Mitchell is in handling the liquid bromine in quantities of one cc. at a time. Dr. Wiley found that the process is made practicable by dissolving both the oil or fat and the bromine in chloroform when the solution is easily handled by means of a special pipette. He described the process in detail and said the determinations should be conducted in a room when the temperature is as constant as possible, and the pieces of apparatus should be exposed to the open air for at least half an hour after completing one determination and before beginning another, in order that it may be restored to the standard room temperature. Duplicates usually agree within one or two-tenths of a degree. The ratio of the heat of bromination to the ordinary number must be established for each system of apparatus employed. The process seems to be one of considerable analytical value. For exact scientific purposes calorimetric measurement of the degree of heat produced must be made.

Prof. Chas. E. Munroe made some remarks upon 'The Corrosion of Electric Mains,' and exhibited sections of electric light cables, in which the lead coating had become so corroded that in some places the interior conductor was exposed, while at others the cable was coated with nodular earthy looking masses. The cables were parts of a three-wire system, which carried a direct current of 110 volts on each wire, and which had been laid underground in the upper compartment of the terra cotta conduit. The corroded main was a branch in an alley, while the principal main was in the street and was not attacked. Analysis showed the incrustation to be nitrate, chloride, carbonate and oxide of lead with water and a trace of organic matter. Surrounding the alley were stables, and in the salts found in the soil produced by the excreta were all the necessary materials and conditions for effecting chemical corrosion *per se* without resorting to any electolytic theory. In the discussion of the paper Dr. Wiley said he thought there might have been a denitrifying process. Prof. Munroe said there had been no submergence of the cable, but that there must have been water passing through the conduit.

A. C. Peale,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, FEBRUARY 25.

Papers under the following titles were presented for publication: 'The Coloring Matter of the Aril of Celastrus scandens,' by Ida A. Keller; 'The Crystallization of Molybdenite,' by Amos P. Brown. The Anthropological Section having precedence, Dr. D. G. Brinton made a communication on the use of the craniofacial line in determining racial and individual characters on the living subject. The relation of the diameters of the cranium, formerly relied on, had been found unsatisfactory. He specially recommended a line closely resembling that suggested by the sculptor, Charles Rochet. It connects the two auditory foramina, forming a slight curve, the superior border of which connects the internal commissures of the eyes. This line, it is claimed, divides the ideal, normal head into two perfectly equal parts, although in nature, of course, this proportion is not maintained, but varies as a racial character and in individuals. The relations of the lines may also indicate the cranial capacity, as the plane of the curve continued posteriorly is approximately the base of the skull. He farther pointed out that the distance between the distal extremities of the curve gives the width of the head and the face, and that a series of curves, described from the fixed points indicated, offers probably the simplest and most accurate method of obtaining significant head-measures on the living subject.

Dr. Harrison Allen commented on the difficulty of obtaining satisfactory cranial measurements and referred to Oldfield Thomas's lines taken from the outer margin of the orbits to determine the projection of the nose. He did not think the true horizontal plane of the skull could be fixed. The so-called Frankfurt plane is the one most commonly accepted.

Dr. Seneca Egbert stated that he had demonstrated the action of the X-rays through plates of platinum from ordinary sun light. Illustrative pictures were exhibited, and the published results of other experiments were discussed.

Prof. Maxwell Sommerville exhibited beautiful specimens of chipped arrow-heads made from common green bottle glass by the natives of northwestern Australia. He also called attention to a stone carved to resemble a miniature grotesque head from the valley of the Delaware opposite Milford, and an object used in phallic worship by the natives of Poonah, India.

Dr. D. G. Brinton called attention to the importance of obtaining systematic data for the study of American anthropology and suggested the wide distribution, under the auspices of the Anthropological Section of the Academy, of circulars of inquiry similar to those in use by the committee appointed by the British Association for the Advancement of Science for the study of the ethnography of Great Britain.

Edw. J. Nolan,
Recording Secretary.

NEW BOOKS.

Atlas of Nerve Cells. M. Allen Starr. New York and London, Columbia College Press, Macmillan & Co. 1896. Pp. x+78 & 51 plates. $10.

Text-Books of General Pathology and Pathological Anatomy. Richard Thoma. Translated by Alexander Bruce. London, Adams and Charles Black. New York, Macmillan & Co. 1896. Pp. xiv+624. $7.00

Electric Wiring. Russell Robb. New York and London, Macmillan & Co. 1896. Pp. 183. $2.50.

Résultats des examen de dix mulle observations de hernies. Paul Berger. Paris, Alcan. 1896. Pp. 206.

Annuaire de l'Observatoire Royal de Belgique. F. Folie. Bruxelles. 1896. Pp. 551.

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*VIVISECTION.**

A STATEMENT IN BEHALF OF SCIENCE.

So long ago as the autumn of 1866 there were published in New York denunciations of the practice of making upon living animals those scientific observations and ex-

* The sciences which have to do with animal experimentation are physiology, physiological chemistry, pharmacology, medical chemistry, toxicology, morphology (including anatomy and embryology), bacteriology, pathology, medicine and surgery. These sciences are largely represented in this country by the American Physiological Society, the American Society of Morphologists, the American Anatomical Society, the American Society of Naturalists, the American Society of Physicians, and the American Society of Surgeons.

In December last the presidents of the above societies were invited to appoint members of a joint committee to sit in Philadelphia on the occasion of the annual meeting in that city of several of these associations.

The accompanying 'statement in behalf of science' was adopted by this joint committee of thirty-four members, and is now published over their signatures, with the addition of several names of persons specially qualified to speak on the subject, but not members of the committee. It sets forth the importance of animal experimentation for the advancement of medicine, and may be accepted as an authoritative expression of expert opinion on this question.

(Signed) CHARLES W. ELIOT,
President of Harvard University.
FRANCIS A. WALKER,
President of the Massachusetts Institute of Technology.
FRANK K. PADDOCK,
President of the Massachusetts Medical Society.
BOSTON, February 24, 1896.

periments which are commonly called vivisections. During the following twenty-nine years there have appeared, from time to time, at one or another place, similar denunciations, more or less sweeping and violent. Of these some condemn vivisection altogether, and others in various of its phases. Some call for its total abolition, and others for its material restriction. Some are labored essays, and others are brief 'tracts' or 'leaflets' intended more easily to arrest the attention. Most of these publications, however, have this in common, that they seek to fortify argument with strenuous appeals to emotion; and in some the tone of invective rises to a shrillness little short of frantic. In these publications, too, there often figure extracts from scientific writings; and, in many cases, these extracts are so garbled that only ignorant or reckless animosity could be accepted in excuse for their seeming bad faith.

During the past twenty-nine years these attacks have but little disturbed the calm of biology and medicine in this country; but, from time to time, it has seemed wise to take some notice of them, inasmuch as the common sense of some members of a changing community is liable to be led astray as to a subject which is largely technical in its nature. The following statement, therefore, is added to its predecessors. Its signers, however, are well aware that they can hardly hope to make any statement or to draw any conclusion which some anti-vivisectionist agitator will not promptly denounce as false or immoral.

Science is simply common knowledge made precise, extended and transmitted from generation to generation of trained observers and reasoners. The biological sciences study in the most varied ways the bodies and the lives of men, of animals and of plants. The applied sciences utilize knowledge thus obtained for the every-day good of mankind; and one of these applied sciences, medicine, brings biological discoveries to bear upon the prevention and cure of disease and injury. As experience grows incessantly, the fact which has laboriously been established with no other thought than the noble one of advancing knowledge may be applied, the next day or the next century, in the most practical way by some inventor or physician; and, in the application, new facts may come to light, which will markedly extend the boundaries of knowledge.

Therefore, in the slowly woven fabric of achievement, pure science and applied science, biology and medicine, have always been warp and woof. Let either be destroyed, man's life shall go threadbare.

To show this, a few out of many striking examples may suffice.

Not very long ago the red clover was imported into a British colony to which it was not native. The plant throve, when planted; but its flowers set no seeds, so that fresh seed had to be brought from the mother country. The disappointed farmers consulted people who had given up their time to the study of plants and insects—botanists, and 'bug-hunters,' in fact. Pure science told the practical farmers that the long-billed humble-bees which sucked honey in every English clover field also carried pollen from flower to flower, and thus fertilized the plants, and that it was useless to try for crops of imported red clover, unless humble-bees were imported also.

No less enlightening is the history of one of the latest and most modern of the developments of science. Near the end of the last century Dr. Galvani, an Italian professor of anatomy, set himself to investigate the cause of a newly discovered fact: namely, that the muscles of the legs of freshly killed frogs jerked forcibly when their nerves were worked upon by the taking of a spark from an electrical machine. This investigation, which does not sound momentous, he undertook, 'in order to discover the hidden properties' of the nerves and muscles, 'and to treat their diseases more certainly.' To the jerks of Galvani's frogs' legs we owe the discovery of the galvanic battery and current, which are named after him; the telegraph and ocean cable, with their immense influence upon civilized life in peace and war; the transfer to miles of distance of the vast working power of Niagara Falls. It is a fitting, if slight, dramatic touch that the traveller in Italy who passes the night at Bologna, where Galvani worked and taught, will perhaps put up at a hotel directly opposite the professor's modest house, and will see that the tablet which records the experiments made within is lighted up at evening by the electric light, which also owes its existence to a search for the hidden 'properties' of frogs' legs.

Two hundred years ago there lived at Delft, in Holland, a well-to-do Dutchman, named Antony van Leeuwenhoek. He had been a 'dry goods clerk' in his youth, and had had no learned or professional training. Van Leeuwenhoek took to making and polishing, for his own use, very small and very strong magnifying glasses, because he was full of what some anti-vivisectionists sneer at as 'scientific curiosity.' The Dutchman's glasses were very superior; and with them he looked at the most miscellaneous things—among these, at ditch water and at particles from the surface of his own teeth. He found that such matters were swarming with living things of all kinds, and described them and other things so well that he became famous, and princes, who were not ashamed to be interested in 'mere science,' sent for him and his glasses to instruct them. Among Van Leeuwenhoek's discoveries were the minute things now called bacteria, or microbes, and known to be living plants. The physicians were prompted to guess that diseases might be due to the ravages of the new forms of microscopic life first seen with decisive clearness by Van Leeuwenhoek; but no proof of this was forthcoming, and the idea was abandoned by most, amid the laughter of many at this fad of the doctors. More than a century went by. The bacteria, as objects of pure science, were more and more studied. The microscope was bettered more and more from the simple magnifying glass of Van Leeuwenhoek. With the advance of chemistry and of other sciences, all known means of studying minute living things became greatly improved; and now the idea that many diseases were caused by minute living things was taken up afresh, and carried to triumphant demonstration by a number of medical men and biologists—among the latter by Pasteur, whose recent loss is mourned by the world, and whom an eminent American humanitarian sneered at, not many years ago, as an 'obscure druggist.' The proof that many diseases are caused each by a particular kind of microbe was obtained by vivisection; for the proof consisted in inoculating animals with the special microbe in question, to the practical exclusion of others, and noting that the animals took the disease, perhaps died of it. As some only of the results of the knowledge thus gained by experiment upon animals, it may be noted that the prevention of cholera has been made more certain, and that great numbers of patients, largely children, have been saved from death by the anti-toxine treatment of diphtheria. But every child thus saved to-day owes his life, not only to medicine, but to biology; not only to the observations and the vivisections of Klebs and Loeffler and Koch and Pasteur and others, but to the 'mere scientific curiosity' of that old lens-polisher of Delft, who spent time in prying into ditch water and particles from the surface of teeth.

Early in the last century, at a country

parsonage in England, there worked a pious and gifted man, the Rev. Stephen Hales, D. D., Rector of Farringdon, in Hampshire. Dr. Hales achieved the uncommon distinction of becoming both an excellent clergyman and a famous biologist. Nor was it to any easy branch of observation that he gave such time as he could spare, but to difficult themes of experimental physiology, both vegetable and animal. He studied, among other things, the pressure of the sap in plants and the pressure of the blood in the vessels of animals. In order to investigate the blood pressure, he did a number of indispensable vivisections upon horses, sheep and dogs. Each animal was tied down, an artery was opened and connected with a pressure gauge, and the true pressures and their variations were for the first time properly observed and recorded. No doubt, had it been possible, the excellent Hales would have drugged his animals to quiet their pain; but modern methods for this purpose were not discovered till long afterward, so that in those days both man and beast faced the surgeon's knife without such relief as they afford. By the work of Hales our knowledge of the circulation of the blood, which his famous compatriot Harvey had discovered, received an essential addition; nor is there reason to suppose that Hales ever doubted the morality of the proceedings by which he satisfied his 'scientific curiosity.' Were he to return to life and to repeat his experiments, even with all modern improvements, he certainly would be surprised at the reception he would meet with in some quarters.

Since the time of Hales those changes in the blood pressure have carefully been studied which are produced in various states of the system and by various drugs. More than a century after Hales some vivisections were performed by Mr. Arthur Gamgee, to test the effect upon the blood pressure of a certain volatile chemical—the nitrite of amyl. It was found that the pressure appeared to be greatly lessened by this drug. Some of these experiments were witnessed by Dr. T. Lauder Brunton, at that time resident physician to the Royal Infirmary at Edinburgh, and now an eminent medical practitioner and professor in London. During the winter of 1866–67 there were in the wards of the infirmary several patients who suffered from the disorder called breastpang, or angina pectoris, which is characterized by paroxysms of hard breathing and of terrible pain over the heart. In observing these cases, Dr. Brunton saw reason to think that the attack was accompanied by a high blood pressure in the arteries. He remembered the vivisections in which he had seen the effects upon the arterial pressure of the nitrite of amyl. He caused his patients to inhale a few drops of the volatile drug. The pain generally disappeared; and the nitrite of amyl became very soon a recognized agent for the relief of one of the most acute forms of human suffering.

Every victim of angina who carries this drug about with him for use at any moment owes his exemption, first, to the scientific physician; second, to the pharmacologist—that is, the scientific student of the action of drugs, who, for the good of man, sacrificed animals in studying the effect of drugs upon the blood pressure; and third, to the clergyman and physiologist, Hales, who a century before had given some pain to animals in studying the science of the circulation, apart from any direct application to the cure of human ailments. Nor is this all; for the experiments of Hales were based upon the knowledge acquired through vivisection by the physician Harvey, who by this means settled much relating to the motions of the heart and blood in animals; which settlement, in turn, depended upon the work of the famous Greek physician, Galen, who seventeen centuries ago proved by vivisections, against his professional opponents, that blood is naturally contained in the arteries.

Of the numerous improvements in practical medicine and surgery which are the outcome of experiments upon living animals we could not speak at length without expanding a brief statement into a book. We will instance further only the vivisections by which, at the time of the Napoleonic wars, Dr. J. F. D. Jones ascertained the proper way to tie up a wounded artery, and thereby afforded the means to military and civil practice of saving very numerous patients from bleeding to death; the experiments of the still living surgeon, Sir Joseph Lister, as the result of which surgery has been revolutionized in our own day; the quite recent vivisections, as the result of which the cure of the disease called myxœdema has been discovered, which cure consists in the administration or transplantation of the thyroid gland; and the vivisections in the seventeenth century relating to the transfusion of blood, as the result of which women in child-bed have repeatedly been rescued from impending death from 'flooding after delivery.'

Experience shows, therefore, that it is impossible to disentangle pure science from applied science; that vital human interests are benefited by 'scientific curiosity,' as well as by work more directly practical; and that this general law holds good for those sciences, pure and applied, which deal with man as such, and with the other living things upon the earth. Without physiology, pathology and their allies, which investigate the laws of life by experiments upon living creatures, practical medicine would be in worse than mediæval plight; for before the Middle Ages the genius of the Greeks had inaugurated the practice of experimental physiology, with results of value for all time.

Therefore, the use of animals by mankind for scientific purposes take its place beside those other uses of them for the good of man which involve imprisonment, enforced labor, death, and, in some cases, suffering. That society asserts with practical unanimity the right to kill and inflict pain upon animals for its own purposes is shown by the legal view of cruelty as the unjustifiable infliction of suffering. Were every infliction of pain as such punishable as cruel, the painful operations, for instance, required to make animals docile, or to fit them to be food, would be abolished. In every great civilized country these operations of the farmyard aggregate millions in each year.

Happily, of the very various procedures known collectively as vivisections, many are painless; in others the suffering is trivial, whether the animal be killed or remain alive; and in the great majority of the rest some drug may be given to quiet pain, or insensibility may be produced by sudden operation. There remains, however, a limited portion of cases, which may be of great importance, where the results of experiment would be endangered by any means that could be taken against suffering. In these cases the animal must suffer, though often far less than would be supposed, for the benefit of man as does the gelded horse or the wounded game.

Common sense requires, therefore, that investigations in biology and medicine shall proceed, at the expense, when necessary, of the death and suffering of animals. If these sciences are not to be extinguished they must be transmitted from generation to generation; they must be taught, and like all the other natural or physical sciences; they must, at institutions of the higher learning be taught by demonstration. No one would think favorably of a student of chemistry who had never handled a test-tube, or of a student of electricity who had never set up a battery. The young astronomer sees the stars and planets themselves through the telescope. So do serious students of biology or medicine see for themselves the structure of the body, see for themselves the workings of that structure through the experiments of the physiological or pathological laboratory or lecture room, just as medical students, they see disease in the wards of hospitals, and look on or assist at the surgical operations performed upon men, women and children. No models and pictures can replace such teaching. From this last fact there is no escape. It is rooted in the constitution of the human mind. No mother would knowingly allow her childern to ride behind a locomotive engineer who had never seen the workings of an actual engine. Surely the physician who does his best to guide the living mechanism along the path of safety should be taught its natural workings as exactly and as fully as possible; otherwise he may understand its working in disease.

Happily the cases where the animals seen at demonstrations must undergo more than brief or trival pain are even rarer than in cases of pure research. In the very great majority of demonstrations the creatures can be kept free of pain until they are killed. As to whether or no, under given circumstances of research or teaching, an experiment involving pain should be performed, is a matter which should rest with the responsible expert, by whom or under whose direction the thing would be done. Otherwise, in a matter involving the interest of the community, those who know would be directed by those who do not know. For any experiment improperly conducted the person responsible is liable under the general laws against the maltreatment of animals. In fact, American biologists and physicians are no more inclined than other members of the community to culpable negligence toward their fellow-creatures. The work of science goes on; but those who are responsible desire, and see to it, that the work be painless, so far as admissible. No intelligent man or woman should give heed to the denunciations of those few ill-informed or headstrong persons who have been drawn into one of the less wise of the agitations which beset modern society.

Signed: S. Weir Mitchell, J. G. Curtis, W. H. Howell, H. P. Bowditch, W. T. Porter, J. W. Warren, R. H. Chittenden, V. C. Vaughan, John Marshall, S. B. Ward, William Pepper, S. C. Busey, Henry M. Lyman, E. G. Janeway, Ch. Wardell Stiles, William Patten, William T. Sedgwick, H. C. Ernst, Theobald Smith, A. C. Abbott, J. J. Abel, A. R. Cushny, H. C. Wood, Frank Baker, Harrison Allen, G. A. Piersol, C. S. Minot, Henry F. Osborn, C. O. Whitman, William H. Welch, T. M. Prudden, R. H. Fitz, George M. Sternberg, J. Rufus Tryon, Walter J. Wyman, Daniel E. Salmon, G. Brown Goode, W. W. Keen, William Osler, J. Collins Warren, W. T. Councilman.

CERTITUDES AND ILLUSIONS: AN ILLUSION CONCERNING REST.

Twenty centuries of investigation have dispelled many illusions. In examining the folklore of the world it is found that the lower the stage of culture the greater the number of these illusions. Since systematic researches were inaugurated by the Greeks many have been explained, yet some remain, even in the scientific world of today. On the threshold of our work it becomes necessary to dispel an illusion developed by primordial men and handed down through sequent generations to the present time, so that even now there are few minds unclouded by its mystic presence. When the ball is in the hand it seems to be at rest; when it flies from the hand motion seems to be created; and when it stops upon the ground motion seems to be destroyed. When the horse stands he seems to be at rest; when he moves motion seems to be created; and when he stops motion seems to be destroyed. The ship is idle in the harbor, and it seems to rest or to be without motion; the winds fill its sail, and it seems that motion is created; it is becalmed at sea and the motion seems to be destroyed. Without the consideration of other unseen facts, rest seems to be a state without motion, and it appears that motion can be created and destroyed. This is the illusion to be dispelled. It is proposed to demonstrate that acceleration in molar motion is deflection of molecular motion, and in general that acceleration in any body is deflection in the particles of the body.

For this purpose it becomes necessary to define what is here meant by the terms body and particle. The universe is discovered to be a hierarchy of bodies. The solar system is a group of stars. When the solar system is considered as a unity the particles of which it is composed are the stars, but when one of these is studied as a unity it is found to be composed of particles. When any one of these particles is considered by itself it is a body. A molecule is a body considered as a molecule, but it is composed of many atoms, which are its particles. If, on the other hand, the atoms are compound, then they are bodies. Thus it is that a body is composed of particles, and that which is a body or system in relation to its component particles may be a particle in relation to a body or system of a higher order. It is in this sense that the term must be understood when we affirm that acceleration in a body or system is deflection of its particles. The ball in the hand is not at rest, or without motion in its particles; the horse has not more motion in its particles when running than when standing; the ship at anchor has motion still in its particles. These propositions are all simple and can be easily demonstrated, and yet the illusion remains. These seeming paradoxes are to be explained if we affirm that motion cannot be created or destroyed.

It has been demonstrated by science that motion is persistent—cannot be created or annihilated, and the demonstration has been accepted by a great body of scientific men. Antecedent to this demonstration Newton had propounded three laws of motion, one of which is that action and reaction are equal and in opposite directions. In this axiom the persistence of motion or the indestructibility of energy was implied, but at first its full significance was not understood, perhaps not even by Newton himself.

In 'The Principia' his first chapter is a series of definitions, the third of which is as follows:

"The *vis insita*, or innate force of matter, is a power or resisting by which every body, as much as in it lies, endeavors to persevere in its present state, whether it be of rest or of moving uniformly forward in a right line.

"This force is ever proportional to the body whose force it is, and differs nothing from the inactivity of the mass, but in our manner of conceiving it. A body, from the inactivity of matter, is not without difficulty put out of its state of rest or motion. Upon which account this *vis insita* may, by a most significant name, be called *vis inertiæ*, or force of inactivity. But a body exerts this force only when another force impressed upon it endeavors to change its condition, and the exercise of this force may be considered both as resistance and impulse; it is resistance, in so far as the body for maintaining its present state withstands the force impressed; it is impulse, in so far as the body, by not easily giving way to the impressed force of another, endeavors to change the state of that other. Resistance is usually ascribed to bodies at rest, and impulse to those in motion; but motion and rest as commonly conceived are only relatively distinguished, *nor are those bodies always truly at rest which commonly are taken to be so.*"

In the last sentence quoted it is apparent that Newton himself was conscious of an illusion in the common conception of the term rest, and it is plain from his entire discussion that his term inertia stood for real force, although many scholars since his time have denied this proposition. Had Newton discovered the real nature of what he called *vis inertiæ* 'The Principia' would have been simplified, as it has been since his time, by definitions given to momentum, energy, force and power. But even these newer definitions can be revised and the subject presented in a simpler manner. The purpose in view in this chapter is to re-define *vis inertiæ*, and to explain the phenomenon of rest in molar bodies by showing that it is not annihilation of motion, but change in the direction of motion, and that the ordinary concept of rest in molar bodies is an illusion, and that this illusion has been carried into the realms of molecular and stellar motions.

Vis inertiæ or inertia is a component of real force, inherent in every particle of matter as speed of motion, which can be changed in direction only through the agency of collision. The explanation of Newton's third law of motion in this manner changes the ideas of motion as they have heretofore existed in philosophy. Motion as speed is inherent, and not something imposed from without. If indeed, this be true, then much reasoning in scientific circles must be revised, for it has far-reaching results.

The correlation of forces through the persistence of motion or the persistence of energy is not universally accepted, but is widely accepted, and it seems to be growing in favor by reason of its great simplicity, and because it furnishes an explanation of many facts and a conceivable explanation for many more, but chiefly from the all-important consideration, attested again and again by observation, that motion is a real cause or antecedent of force and that no other cause is known. A second explanation of force is never even propounded except as a reification of abstractions inherited from the age of metaphysics, and still found as an atavism in science.

In the consideration of motion it is necessary to consider the two elements, namely, speed and direction, or path, for each term posits the other. The persistence of motion inheres in the element of speed. While the body in motion must have a path its direction is variable, *i. e.*, not persistent as a right line. It must therefore be understood that in speaking of the persistence of motion it is the element of speed to which reference is made. To affirm that motion is persistent is equivalent to the affirmation that speed is persistent, though the path of motion may change. It is not proposed here to discuss the conservation of energy nor the kinetic hypothesis that force is the collision of matter in motion, but to assume these theories for the purpose of exhibiting their logical consequences.

In every collision of one particle or body with another there is a double correlative involved. When A and B collide, A acts on B and B on A, so that there is both action and passion in A and B which are coexistent. Then we have to consider A before the collision and A after the collision, and B before the collision and B after the collision. There is thus a double cause and a double effect which are sequent. The matter may be expressed in another way. A and B coöperate in producing effects on each other. In this coöperation action and reaction are involved. The action is the cause and the reaction is the effect. How is the cause quantitatively related to the effect and how is the effect divided between them? It is proposed to prove that collision does not produce any change in the speed of A or B, but the result of the collision is the deflection of the paths of both and this deflection is proportional to their masses. All this is simple in the collision of two free bodies of a certain class, both of which are in motion and which collide when their paths impinge upon each other. But two bodies, A and B impinge. A is without molar motion; B has molor motion. Will B yield a part of its motion to A, or will B retain its motion as in the case of two free moving bodies and create motion in A? Or if A is unmoved and B is stopped in its molar motion will motion be annihilated? If two molar bodies are free and both in motion and their paths impinge, neither particle has its speed increased or diminished, but if one is at rest it will be put in molar motion and it will thus appear to have motion given to it either by the creation of motion or by taking it from the other. The illusion involved arises from this, that the molar body said to be at rest is really not at rest. If they are both free and in motion it is plain that one does not yield motion to the other. But if one of the bodies is in the state called rest it appears that it is set in motion or that the other body is brought to rest. In the first case it seems that motion is not created nor annihilated, in the second that motion is created and in the third that motion is annihilated. Is this true? This is the question we are to answer. Can motion in any body be created or destroyed by collision? It appears so, but we are to show that this appearance is an illusion.

Every particle of matter known to man is in motion at a high velocity. This wooden ball is in motion about the axis of the earth, about the sun, and also with the sun about some other point in the heavens. The sum of all these motions considered as speed is unknown, but it may be affirmed with safety that it is very great. Let us call this the telluric motion of the ball, its motion with the earth. Its path is composed of at least three contemporaneous revolutions. However great the speed of the telluric motion, it is yet small as compared with other motions within the body itself. As now understood the woody tissue is composed of cells, the cells of molecules, and the molecules of atoms, all grouped in such a manner by composed motion as to constitute a tissue whose structure is preserved by molecular motion. That rigidity is sometimes due to motion is well known. Stand by the nozzle of a monitor with four hundred feet of pressure behind the water and watch the stream drive the great boulder away. Strike this stream with a crowbar; though the iron may bend, the stream is unbroken. So we may conceive that rigidity and strength of structure are properties of motion. Let us call this rigidity and structural strength of the woody tissue constitutional motion, whose force is equal to the sum necessary to rend the ball into its constituent atoms. The structural strength is a measure of its constitutional motion, which is great as compared with any molar motion observed in the ball. Again the body exhibits a mode of motion known as heat, which is undulatory or vibratory. Of the speed of radiant heat something is known, and it is well-known that it is very great as compared with any molar motion observed in the bodies which exhibit the heat. Let us call this constitutional and thermic motion molecular motion.

I roll the ball over the floor, and molar motion is exhibited to the vision.

Thus we know of three kinds of motion possessed by the body, but that which is apparent to the unaided vision as molar motion is but a minute part of the whole. It is evident that it is a very small part of the telluric motion. Let us now see what proportion it bears to the molecular or the constitutional and thermic motions combined. The constitutional motion is measured by the force with which the atoms, molecules and cells are held together as an organic body. If we attempt to realize this we find it very great, yet we cannot attain to its measure, from the fact that it is complicated with the heat motion of the body, but we can obtain some realization of the sum of the two kinds of motion, though we cannot with certainty divide the molecular motion between them.

Let us first consider the velocity of reasonably well-known molecular motion:

Velocity of Gas Molecules.

	Meters per second.
Atmospheric air	485
Oxygen	425 to 458
Nitrogen	453 to 491
Hydrogen	1838 to 1841
Ammonia	628 to 737
Aqueous vapor	614

Velocity of the Transmission of Sound.

	Meters per second.
In air	333
" oxygen	317
" hydrogen	1270
" ammonia	415
" water	1435

But all of these same molecules have the motion of the earth, first about its axis, which at the equator is 465 meters per second, and in orbit 29,606 meters per second. Neglecting the motion of the earth with the sun about some other point in the heavens we still see that the known molecular motion, plus the known telluric motion, which we have considered, far exceeds any molar motion observed in nature or produced in art. The molecular motion of a cannon ball at its mouth is from 518 to 671 meters per second. In telluric motion we have the motion of bodies, and again in molecular motion we have the motion of bodies. The molecules themselves are compound, and in order that the molecular bodies themselves should retain their constitution it is necessary that the motion of their particles should be made immensely composite as correlative motions. What idea can we obtain of the velocity of this particle motion? Take the wooden ball which we have considered and burn it and we have motion as light, and light is transmitted at the rate of 299,878,000 meters per second. Here we have particle motion at a velocity so great that any observed molecular motion sinks into insignificance; all of the ethereal motions seem to be at least of rudely commensurate magnitude. If the atoms are compound, as seems to be indicated by a large body of evidence obtained through chemical research, possibly it may be that the particles of atoms are commensurate with the particles of ether and that they have the same speed; but this hypothesis is not necessary to the present argument. It is only necessary to show that the molecular and constitutional motions, together with the telluric motions of every particle, are of such a magnitude as to fall far within the speed of molar motion.

None of these motions are persistently right-line motions. It is manifest that the stellar motions are great revolutions. The constitutional motions are also enormously composite. The heat motions, though they may be right-line motions in minute parts, must be composite motions, their paths forever changing, else the body would be dissipated. The particle motion of each particle in the molecule has its path confined to the sphere of the molecule itself. Considering this motion, both structural and thermic, not in relation to telluric motion nor in relation to molar motion, but wholly in relation to the particles of the molecule, it must be highly composite. The molar motion of the rolling ball is revolution and translation, but it is so small as compared with the others that it hardly seems worthy of consideration. Still it must not be neglected, for this is the motion the characteristics of which we have set out to explain. Let us once more consider what has been said. The atoms of the ball, when all their motions are analyzed and summed, prove to have enormous velocities in enormously composite paths compared with which the molar motion of the ball on the floor sinks into insignificance.

Every particle in the wooden ball rolling on the floor has telluric motion, molecular motion and molar motion. Consider one of these particles moving with the three kinds of motion, and we realize that its speed is very great and that the path which it traverses is greatly composite. If such a particle had its composite path straightened into a right-line path it would at once pass out of the sphere of the solar system into a region beyond, from whatever point within the system it might start, and in whatever direction the right-line path extended. But the molecule remains within the solar system because its stellar motion is composite; and it remains within the ball because its molar motion is composite; and it remains within the molecule because its molecular motion is complete.

When the ball was started molar motion began and when it stopped that molar motion ended. But we do not suppose that it came out for nothing and vanished into nothing; we resort to preëxisting molecular motion to explain it; we say that the molar motion was derived from the molecular motion of the hand that set the ball rolling and that it was transformed into molecular motion in the wall which destroyed the molar motion. In making this explanation we assume that motion as speed went out of the hand into the ball and then out of the ball into the wall. Is this true? Was the velocity of the molecular motion in the hand diminished and the velocity of the molecular motion in the wall increased? If so, action and reaction are not equal except in the sense that what is lost by one is gained by the other.

Did motion go out of the hand into the ball, or was the direction of motion existing in the ball changed? Did motion go out of the ball into the wall, or was the direction of motion existing in the wall changed? If the law of action and reaction is valid, when the change was made upon the ball by the hand, an equal change was made upon the hand by the ball. Neither of them lost velocity by the changed form, or one lost what the other gained. All of Newton's reasoning on this subject proceeds upon the assumption that the speed of each is unchanged, but that the direction of each is changed and that this deflection is equal in the case now considered. When the ball struck the wall neither ball nor wall lost motion, but the molecular paths were changed by collision. The form or mode of direction of motion was affected, the quantity of motion as speed was unaffected, if we follow Newton's reasoning. But there was a change in the hand, in the ball, and in the wall. In what did that change consist? We know that in part at least it consisted in a change of paths. The molecular motions in the hand must have had their directions changed; the molecular motions in the ball must have had their directions changed; in like manner the molecular motions of the wall were changed in direction. This we know; in every collision there is a change of direction in the motion of the particles constituting the bodies colliding. Is this change of direction all? Or is there a transference of speed so that one loses while another gains? The whole problem is narrowed to this issue—that which we call acceleration is wholly deflection or in part deflection and in part loss and gain—loss of speed by one and gain by another, and if there is any loss and gain then action and reaction are not equal, as Newton's law affirms.

There is still another set of relations which must be considered. A body is constituted of particles; that the motion of the particles within the body should remain within the sphere of the body, their paths must be composite. In order that their paths may be composite there must be a sufficient number of collisions to deflect these several particles and retain them within that sphere.

If the body itself is moved the paths of the several particles in the average must thus be rendered less composite, that is, the number of collisions must be diminished. The motion of the body as such, therefore, is accomplished by diminishing the deflections within the body and straightening their paths. The translatory motion of a body is a straightening of the paths of the particles of which the body is composed.

Imagine a man walking in a circle of ten feet radius. The sphere of his motion is within the circumference. He may soon walk a mile and never be more than twenty feet away from any given point in the circumference; change his direction so that his path is straightened, and he may soon be a mile away. A body of men walking in a circle remain together as a body within the circumference of the circle as it moves with the earth; change their paths to a cycloid and the body of men will move away or change their paths to parallel right lines, and as a body they may soon be a mile away and still in a circle. In the same manner the molecules of the wooden ball are in motion within the theater of the ball, so that they do not pass beyond its boundaries, yet impose upon each molecule a change of direction in such manner that they all move a little more in one course and a translation of the ball is affected by a change of direction in the motion of its constituent molecules, and the ball still remains as an incorporated body. It is thus possible to explain molar motion of the ball as a change in direction of the motion of its molecular parts, without assuming an increase of speed in the parts. By such an assumption the molar motion perceived by vision would be legitimately derived from the molecular motion known by reason, and appear as a change of direction in the telluric motion of the ball.

No motion would be created or destroyed, and action and reaction would remain equal, while the apparent molar motion would be explained by a change of direction in molecular motions, very minute as compared with the composite paths of the several molecules and the composite path of the body in its telluric motion. When we consider the total motions of the atoms of the ball, even when it is shot from a cannon's mouth, an inconceivably small change of direction in the motion of every atom as compared with the complexity of its path would fully account for the flight of the ball as projected by dynamite.

Now we know of deflection and that it arises from collision, and we know of no other change in motion. Acceleration as increase of speed cannot in the nature of the case be demonstrated, for it may always be explained as deflection, and can never be explained without deflection; and to assume acceleration as increase of velocity is to contradict the law that action and reaction are equal and to affirm that motion can be created and destroyed.

If acceleration is explained as deflection, it is explained by referring it to a known cause and adequately explained.

Let this argument be stated in brief:

First, the tendency of modern investigation is to explain all forces as derived from modes of motion. Great progress has been made in this direction, and the theory is widely accepted.

Second, all understood forces are collisions.

Third, if all forces are collisions the motions from which they result obey the third law of motion, that action and reaction are equal. By this law it is seen that no motion as speed can be lost or gained by any particle of matter.

Fourth, by collision paths can be changed, but motion as speed cannot be transmitted.

Fifth, in molar motion there is an apparent creation and annihilation of motion, but this appearance is known to be an illusion. It has been explained as due in part to collision and in part to the transmission of motion. Acceleration, therefore, must be something else than an increase of speed. It is known to be in part deflection and can all be thus explained; and if the first law of motion is valid it is thus explained. Therefore:

1. Molar acceleration is deflection of molecules.

2. Speed of motion in matter is constant.

3. The direction of motion is variable.

4. Speed is inherent in matter and is not imposed upon it from without.

5. The path of motion is controlled by environment.

The laws of motion propounded by Newton can be more simply stated as follows:

Law I. The velocity of motion is persistent.

Law II. By the collision of two bodies the direction of their motions is changed in equal components.

Vis inertia is the power which particles have of deflecting each other by collision, due to their persistent motion.

Every particle has perpetual motion as speed which can not be increased or diminished, and the absurdity of perpetual motion should be called the absurdity of perpetual collision. The particles collide because of impinging paths; they are deflected and their paths are turned apart and they cannot be made to collide again until other external collisions bring their paths together. If the particle A after one collision is once more deflected, another collision is necessary. It is thus that the absurdity of perpetual collision can be simply demonstrated. After such an analysis the explanation of gravity as the mutual protection from impinging particles becomes simple, the doctrine of virtual velocities self evident; and there are many other consequences of this law which, properly understood, would make many propositions of physics self-evident.

It must be clearly understood that the above argument does not deny that the motion of a body cannot be accelerated in speed; such a denial would be an absurdity. Every particle of which we have knowledge is a constituent of many bodies in a hierarchy of bodies and what is here affirmed is that the acceleration of a body in speed is deflection of its particles, and that embodiment itself is always a result of deflection in the particles embodied. A molar body may have its molar motion increased or diminished in speed by deflecting its molecular motions. If the speed of a molar body be changed, the direction of its molecular particles must necessarily be changed. This proposition is self-evident. The third law of motion is equally simple. The law here demonstrated affirms that acceleration in one embodiment is deflection in another and it makes valid Newton's law, which would be an absurdity were the law here demonstrated untrue; and if untrue the persistence of motion is an absurdity, and with it the persistence of energy falls to the ground.

J. W. POWELL.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

THE *Astronomische Nachrichten* of February 22d contains an article by Dr. H. F. Zwiers, giving a new method of computing double-star orbits, and an application of it to the orbit of Sirius. The author does not claim great precision for his orbit of his star, and it is given simply as an illustration of his method of computation. We do not think, however, that the method will commend itself very greatly to astronomers. Glasenapp has pointed out (*Orbites *des étoiles doubles*, p. q.), that the application of graphical methods to the problem in question ought to cease with the drawing of the apparent ellipse. After this has once been drawn, the computation by Kowalski's elegant formulæ does not require more than half an hour.

The same journal contains an account of some very interesting experiments which have been made at the Munich Observatory, by Dr. Schwartzschild. A new form of micrometer has been constructed, using the principle first employed in 1891 by Michelson for the measurement of the satellites of Jupiter. This new micrometer has been applied with the help of a ten-inch telescope to the measurement of a number of close double stars. Briefly stated, the new instrument consists of a movable plate, pierced with several slits, and mounted outside the object glass of the telescope. This produces a series of spectra of both the principal star and the companion in the field of view of the telescope. By revolving the slit plate until the spectra of both stars are all in a straight line in the field of view, it is possible to measure the position angle. Similarly, by a sliding motion of the slit plate, the spectrum of the companion can be made to appear exactly midway between two neighboring spectra of the principal star. From a reading of the scale attached to the slit plate it is then possible to compute the angular distance of the component from the principal star. The whole apparatus is very simple and inexpensive, and could be applied easily to any equatorial provided with a position micrometer. Thirteen stars have been measured with this instrument by two observers. The distance for the closest double is $0''.86$, while the greatest distance measured was $4''.25$. Distances over five seconds could not be measured accurately, because at this distance the spectra begin to show too much color for accurate observation. The probable errors of these observations compare very favorably, indeed, with those obtained for other forms of micrometric apparatus, especially in the case of very small distances. But as is well known, the very close doubles are the ones most important to measure.

The last number of the *Astrophysical Journal* contains an account of the progress made with the new observatory of the University of Chicago. An interesting feature of the new institution is to be a complete optical and mechanical instrument maker's outfit. And an optician as well as an instrument maker are to be permanently attached to the observatory staff.

H. J.

MARINE ORGANISMS.

The Friday evening discourse at the Royal Institution on February 29th was delivered by Dr. John Murray, of the Challenger expedition, who spoke on 'Marine Organisms and their Conditions of Environment.' According to the report in the London *Times* Dr. Murray pointed out that in the distribution of marine organisms temperature was a more important factor than in the case of air-breathing and warm-blooded animals on the land surfaces, although in the ocean the extreme range of temperature never exceeded 52 deg. Fahr. In the surface waters of the ocean there were five well-marked temperature areas—an Arctic and an Antarctic circumpolar belt with a small range and a low temperature, a circumtropical belt with a small range but a high temperature, and two intermediate areas with large annual ranges of temperature. The waters of the ocean might be divided into two great regions—the superficial region down to about 100 fathoms, and the deep-sea region. In the former, and especially in the marginal zone surrounding the land, there was great variety of conditions and an abundant fauna and flora, whereas under the uniform conditions found in the deep-sea plant life was absent, though there was animal life in abundance. In the warm surface waters of the tropics there were many species, but relatively few individuals, while the reverse condition was found in polar areas. Again, in tropical pelagic regions organisms secreting carbonate of lime were abundant, but gradually disappeared towards the poles. In the warm waters the pelagic larvæ of bottom-living species were always found, but in the cold appeared to be absent. The lecturer was of opinion that the various facts in the distribution of marine organisms might be accounted for by supposing that in early geological times there was a uniform climate over the whole surface of the globe and an almost universal fauna and flora. The coral reefs that flourished within the Arctic Circle in the Palæozoic period were formed when the water in the polar regions had probably a temperature approaching 70 deg. Fahr., and when cooling set in those animals with pelagic larvæ and those which secreted carbonate of lime would either succumb or be forced to retire to warmer waters, those having a direct development surviving. Cold water descending from the poles into the deep sea would carry oxygen with it and render the deep regions habitable, thus initiating migrations from the mud line. The elimination of the same elements, in the manner indicated, from the two polar faunas would account for their resemblance and even identity, as well as for the similarity of the polar and deep-sea faunas and the absence of truly ancient types in the deep sea.

GENERAL.

IT is expected that there will be present an unusual number of foreign guests at the Liverpool meeting of the British Association (Sept. 16–23). A special scientific excursion to the Isle of Man has been provided. The geology of this island is varied and interesting, especially as regards igneous and glacial formations, and fossil-bearing carboniferous limestones; the Prehistoric, Scandinavian and other early remains are celebrated, the marine fauna and flora are abundant, and the presence of the Liverpool Marine Biological Station at Port Erin will be a special attraction to all naturalists. Prof. W. A. Herdman, of University College, Liverpool, is chairman of the local committee.

THE Polarizing Photochronograph devised by Lieut. G. O. Squier, U. S. A., and Mr. Albert C. Crehore, has been recognized by the Franklin Institute of Philadelphia, which has given them the John Scott endowment medal for 1895.

THE life of Prof. A. W. von Hoffman, founder and long president of the German Chemical Society, will be written by a committee of the Society, composed of his successor, Prof. E. Fischer, Dr. Martius and Prof. F. Tremann.

THE scholarships for some time maintained at the Naples Zoölogical Station by the Universities of Oxford and Cambridge are to be continued.

PROF. SIMON NEWCOMB has been elected a member of the Royal Academy of the Lincei at Rome, and also made an officer of the French Legion of Honor.

PROF. H. A. ROWLAND, of Johns Hopkins University, has been made an officer of the French Legion of Honor, foreign correspondent of the French Academy of Sciences, and foreign member of the Italian Society of Spectroscropists.

ALL teachers of natural science are invited to join in a movement to raise the requirements in science for admission to college, by attending the next meeting of the National Educational Association at Buffalo, July 3–11, 1896. At the Denver meeting, 1895, a Department of Natural Science Teaching was organized, as a regular part of the National Educational Association, with the following officers: Prof. C. E. Bessey (Lincoln, Neb.), President; Prof. Wilbur S. Jackman (Cook County Normal School), Vice-President; Prof. Chas. S. Palmer (Boulder, Colo.), Secretary. The Western States have taken the lead, but it is hoped that all college and high-school teachers of science will unite in the movement. A good program, including special papers on the various topics in physics, chemistry and biology, is now being arranged and will soon be published.

PROF. M. I. PUPIN, of Columbia University, will lecture in the New York Academy of Sciences on March 23d, on 'Röntgen's Discovery.' The lecture will be illustrated by experiments and lantern views.

MACMILLAN & CO. have issued cards of the standard library size giving the publications of the Columbia University press. In addition to the ordinary bibliographical details each card contains a synopsis of the contents of the volume. The cards need to have only the library reference number added and can then be placed without further copying in the card catalogue.

A BRONZE memorial tablet in memory of the late Prof. George Huntingdon Williams, who occupied the chair of inorganic geology at the Johns Hopkins University, will be placed in the Williams memorial room of the geological laboratory, which contains the collections made by Prof. Williams.

Garden and Forest states that the Puget Sound University owns what is called a residence park of some twelve hundred acres southwest of the city of Tacoma, and it is proposed to devote some two hundred acres of this, where the soil is most suitable, to an arboretum of such trees as will grow in the remarkable climate of that region. The amount of land available is so ample that room can be given for a large collection. Some ten thousand young plants of two hundred and fifty species, native and foreign, already form the nucleus of the proposed tree museum.

THE first two papers of Vol. VIII., of the Bulletin of the American Museum of Natural History are by Mr. Frank M. Chapman, and discuss the changes of plumage in the Dunlin and Sanderling and in the Snowflake. Herr Gätke says that the change of color in the Dunlin and Sanderling takes place without molt and is due to changes in the feathers themselves, but Mr. Chapman shows that in passing from winter to summer plumage the Dunlin undergoes a complete molt of the body feathers and scapulars, but retains the rectrices and remiges; the change in the Sanderling is also due to molting. In regard to the Snowflake, Mr. Chapman states that they molt once a year, after the breeding season, and that the difference between the dress of September and that of the following spring is due to a wearing away of the edges of the feathers by which both their shape and color are changed.

M. DEPERRET, professor at Lyons, has described before the Paris Academy remains of dinosaurs found in Madagascar twenty-five miles south of Majunga. These seem to show close affinities with the fossils of British India.

As we have already had occasion to state, the work of a large proportion of the physicists of the world seems to have contributed but little to the results published by Prof. Röntgen, though an exception should be made in the case of the paper presented to the Royal Society by Prof. J. J. Thomson. It is perhaps not surprising that the daily newspapers should publish all sorts of reports, even seriously explaining how at the College of Physicians and Surgeons, New York, the Röntgen rays are used to reflect anatomical diagrams directly into the brains of students, making, we are informed, much more enduring impressions than the ordinary methods of learning anatomical details. It seems, however, unfortunate that *Nature* should publish from its 'American correspondent' unconfirmed newspaper reports and that the Paris Academy should admit five consecutive papers on 'dark light,' apparently without scientific validity.

IT is stated in *Electricity* that, in connection with the Electrical Exposition to be held in New York during May, arrangements have been made for an interesting historical and loan exhibit, to which it is intended to devote considerable space on the main floor. A committee composed of T. Comerford Martin, Dr. Park Benjamin and E. L. Morse has charge of the exhibit. Dr. Benjamin has one of the finest libraries in the world of early books on electricity, and these will be shown in cases arranged chronologically, with explanatory notes, portraits, autographs, etc. Mr. Morse, the son of Prof. S. F. B. Morse, is the possessor of an invaluable collection of telegraphic relics, curios, documents, etc., including his father's note books and sketches, all of which will be shown. Mr. Martin, besides owning many objects of interest connected with the early days of electricity, has secured from Mr. Tesla, Prof. Elihu Thomson, Mr. Edison, Mr. Edward Weston, Mr. Stieringer and others the loan of early and interesting apparatus.

AT the anniversary meeting of the Geological Society of London, on February 22d, the officers for the ensuing year were elected as follows: President, Henry Hicks; Vice-Presidents, Prof. T. G. Bonney, Prof. A. H. Green, R. Lydekker and Lieutenant-General C. A. M'Mahon; Secretaries, J. E. Marr and J. J. H. Teall; Foreign Secretary, Sir John Evans; Treasurer, W. T. Blanford. The Council were also appointed. The retiring President, Dr. Henry Woodward, delivered his anniversary address, which dealt with the life history of the crustacea in later palæozoic and in neozoic times. The Wollaston medal was awarded to Prof. E. Suess, the Murchison medal and part of the proceeds of the Murchison fund to T. Mellard Reade, and the Lyell medal and part of the proceeds of the Lyell fund to A. Smith Woodward.

THE Academy of Science of the University of Oregon was organized at Eugene, Ore., on January 10th. A constitution was adopted and Prof. Condon was elected President; Dr. T. W. Harris, Vice-President, and Prof. F. L. Washburn, Secretary and Treasurer. At the first regular meeting, which was held on January 25th, Prof. Condon read a paper on 'Two recently discovered fossils,' and several informal communications were presented.

PROF. AGASSIZ and his party, which includes Dr. W. McM. Woodworth and Dr. A. G. Mayer, are now in San Francisco, and will sail shortly for Australia in the steamship Monowai. A steamer has been chartered in Australia for the expedition to the Great Barrier Reef.

MR. J. B. HATCHER, of Princeton College, special agent and collector for the Bureau of Ethnology at Washington, and Mr. O. A. Peterson, collector for the American Museum of National History, New York, have embarked for Patagonia on the steamship Galileo.

A PARISIAN company has placed pneumatic tires on twenty of its cabs. It is claimed that these not only add greatly to the comfort of those using them, but also effect an actual economy. The average cost for repairs on a Paris cab is about 50 cents a day, and it is said that the pneumatic tires reduce this to one-half. The weight saved in the tires is about 100 lbs. and the whole vehicle may be built more lightly. It is also probable that even apart from the decrease in weight it is easier for a horse to draw a carriage with pneumatic tires.

WE take from *Natural Science* the following items: An expedition of sixteen men, headed by Dr. Cook, has started in two small vessels of 100 tons each for the bay of Erebus and Terror. Six of the men are students of science. The naturalists, Messrs. Austen and Cambridge, on the Siemens telegraph expedition to the Amazon, have already begun successful operations, the fact that the 'Faraday' was stuck for a whole week on a mud-bank at the west end of Parana de Buyassu in no wise interfering with the aims of the collectors. The chief find at present has been two specimens of *Peripatus*, belonging apparently to different species. The naturalists decided to stay at Santarem, while the 'Faraday' proceeded to Manaos, which place it reached on February 8th, all well. Prof. H. de Lacaze Duthiers will, as in former years, conduct an excursion at Banyuls during the Easter vacation, that is, from March 28th to April 11th. Those joining the party can obtain return tickets from Paris to Banyuls for 46 francs. Among those who will attend are Professors Von Graff, of Graz; Pruvot, of Grenoble, and Yung, of Geneva, and probably some naturalists from Barcelona. The Professor desires to extend through us a cordial invitation to any English naturalists. The hydrographical exploration of the Skagerack has just been begun under the auspices of the Swedish government and the direction of Prof. O. Pettersson.

UNIVERSITY AND EDUCATIONAL NEWS.

THE bill establishing a National University of the United States has been reported favorably by the Senate committee. It grants a charter to the University, provides for its government, grants it the ground in the city of Washington designated by President Washington as a site for a national university, and appropriates $15,000 for the fiscal year ending on June 30, 1897, and $25,000 for the year following.

AT the recent meeting of the Board of Trustees of the College of New Jersey at Princeton it was voted to change the charter name of the institution to Princeton University. The fund which is being raised in commemoration of the Sesquicentennial next October is already over $900,000, a large proportion of which, it is said, will be devoted to the development of the graduate department.

AT a special meeting of the Yale corporation it has been decided to construct a new dormitory on York street to cost $100,000.

PROF. JAMES SETH, now of Brown University, has been elected professor of ethics in Cornell University.

THE promotion of Associate Prof. George F. Atkinson to the professorship of botany at Cornell University will be followed by a reorganization of the courses of instruction in the department which will go into effect at the opening of the coming year. Assistant Prof. W. W. Rowlee has been promoted to the highest grade of assistant professor; E. J. Durand, Sc. D., has been appointed instructor in botany, and K. M. Wiegand, assistant. The following advanced and graduate courses in botany are offered for the coming year: By Prof. Atkinson and Instructor Durand, comparative morphology and embryology, mycology and algology. By Assistant Prof. Rowlee and Assistant Wiegand, comparative histology, systematic botany and dendrology.

ADJUNCT PROF. W. H. ECHOLS has been elected by the Board of the University of Virginia to the full chair of mathematics to succeed Prof. C. S. Venable, who retires on account of ill-health. J. Morris Page, of Johns Hopkins University, has been elected adjunct professor.

THE senate of Cambridge University has rejected the proposition to appoint a committee to consider the question of conferring degrees upon women by a vote of 186 to 171.

DISCUSSION AND CORRESPONDENCE.

HEREDITY AND INSTINCT.*

IN his able posthumous work on *Post-Darwinian Questions, Heredity and Utility*, the lamented G. J. Romanes sums up the evidence for the inheritance of acquired characters in the final statement that only two valid arguments remain on the affirmative side; and to each of these arguments he has devoted considerable space. One of these arguments is from what he calls 'selective value,' and the other from the 'co-adaptations' found in the instincts of animals. He says (p. 141): "Hence there remain only the arguments from selective value and co-adaptation." If we take the instincts as illustrating also the application of the principle of 'selective value,' we may gather the evidence which Mr. Romanes was disposed to cling to for the inheritance of acquired characters into a single net, and enquire as to the need of resorting to the Lamarckian factor in accounting for the origin of instinct. I wish to suggest some considerations from the psychological side, which seems to me entirely competent to remove the force of these two arguments, and to show to that extent that the instincts can be accounted for without appeal to the hypothesis of 'lapsed intelligence,' as the use-hypothesis, as applied to this problem of instinct, is called; in other words, to show that Darwin and Romanes were not correct in considering instinct as 'inherited habit.'

The argument from co-adaptation requires the presence of some sort of intelligence in an animal species; the point being that since the coördination of muscular movements found in the instincts are so co-adapted they could not have arisen by gradual variations. Partial adaptations tending in the direction of an instinct would not have been useful; and intelligence alone would suffice to bring about the coördinations which are too complex to be accounted for as spontaneous variations. These intelligent coördinations then become habits by repetition in the individual and show themselves in later generations as inherited habits due to 'lapsed intelligence.' Assuming, then, with Romanes—whom we may take as the most recent upholder of the view—the existence of some intelligence in a species antecedently to the appearance of the instinct in question, we may be allowed that supposition and resource.

I. But now let us ask how the intelligence brings about coördinations of muscular movement. The psychologist is obliged to reply: Only by a process of selection (through pleasure, pain, experience, association, &c) from certain alternative complex movements which are already possible for the limb or member used. These possible combinations are already there, born with him, or resulting from his previous habits. The intelligence can never, by any possibility, create a new movement, or effect a new combination of movements, if the

*Discussion (revised), following Prof. C. Lloyd Morgan before the New York Academy of Sciences, January 31, 1896.

apparatus of brain, nerve and muscle has not been made ready for the combination which is effected. As far as there are modifications in the grouping, even these are very slight functional variations from the uses already made of the muscles involved. This point is no longer subject to dispute; for pathological cases show that unless some adequate idea of a former movement made by the same muscles, or by association some other idea which stands for it, can be brought up in mind the intelligence is helpless. Not only can it not make new movements; it can not even repeat old habitual movements. So we may say that intelligent adaptation does not create coördinations; it only makes functional use of coördinations which were alternatively present already in the creature's equipment.*

Interpreting this in terms of congenital variations, we may say that the variations which the intelligence uses are alternative possibilities of muscular movement. But these are exactly the variations which instinct uses, except that in instinct they are not alternative. That this is so, indeed, lies at the basis of the claim that instinct is inherited habit. The real difference in the variation involved in the two cases is in the connection in the brain whereby in instinct the muscular coördination is brought into play *directly* by a sense stimulation; while in intelligence it is brought into play *indirectly*, *i. e.*, through association of brain processes, but by the same sense stimulation or a similar one. Now this difference in the central brain connections is, I submit, not at all a great one relatively speaking, and it might well be due to spontaneous variations. The point of view which holds that great co-adaptations of *musculatur* are to be acquired *all at once* by the creature is quite mistaken.

The same class of considerations refutes the argument from 'selective value.' This argument holds that the instinct could not have arisen by variations alone, with natural selection, since partial coördination tending in the direction of the instinct would not have been useful; so the creatures with such partial coördinations merely would have been killed off, and the instinct could never have reached maturity; only variations which are of sufficient value or utility to be 'selective' would be kept alive and perfected.

But we see that the intelligence which is appealed to, to take the place of instinct and to give rise to it, uses just these partial variations which tend in the direction of the instinct; so the intelligence *supplements* such partial coördinations, makes them functional, and so *keeps the creature alive.* In the phrase of Prof. Lloyd Morgan, this prevents the 'incidence of natural selection.' So the supposition that intelligence is operative turns out to be just the supposition which makes the use-hypothesis unnecessary. Thus kept alive, the species has all the time necessary to perfect the variations required by a complete instinct. And when we bear in mind that the variation required is, as was shown above, not on the muscular side to any great extent, but in the central brain connections, and is a slight variation for functional purposes at the best, the hypothesis of use-inheritance becomes not only unnecessary, but to my mind quite superfluous.

II. There is also another great source open to the Neo-Darwinian in this matter of instinct; also a psychological resource. Weismann and others have shown that the influence of animal intercourse, seen in maternal instruction, imitation, gregarious coöperation, etc., is very important. Wallace dwells upon the actual facts which illustrate the 'imitative factor,' as we may call it, in the personal development of young animals. I have recently argued that Spencer and others are in error in holding that social progress demands the use-hypothesis;* since the socially-acquired actions of a species, notably man, are socially handed down; giving a sort of 'social heredity' which supplements natural heredity. And when we come to enquire into the actual mechanism of imitation on the part of a young animal we find much the same sort of function involved

* When we strain our muscles to accomplish a new act of skill we are aiming to use the apparatus in new ways by a selection from possible combinations; and even when we learn to use disused muscles, as those of the ear, we are only stirring up old connections.

* SCIENCE, August 23, 1895, summarized in *Nature*, Vol. LII., 1895. p. 627.

as in intelligent adaptation. The instinct to imitate requires a general tendency to act out for himself the actions which the animal sees, to make the sounds which he hears, etc. Now this involves connections of the centers of sight, hearing, etc., with certain muscular coördinations. If he have not the coördinations he can not imitate; just as we saw above is the case with intelligence, if the creature have not the apparatus ready, he can not use it intelligently. Imitation differs from intelligence in being a general form of coördinated adaptation, while intelligence involves a series of special forms.* But both have to have the apparatus of coördinated movement. So we find, as an actual fact which all agree upon, that by imitation the little animal picks up directly the example, instruction, mode of life, etc., of his private family circle and of his species. This then enables him to use effectively, for the purposes of his life, the coördinations which become instincts later on in the life of the species; and again we have here two points which directly tend to neutralize the arguments of Romanes from 'selective value' and 'co-adaptation.' The co-adaptations may be held to be gradually acquired; since the coördinations of a partial kind are utilized by the imitative function before they become instinctive. And the law of 'selective value' does not get application, since the imitative function, by using these muscular coördinations, supplements them, secures adaptations, keeps the creature alive, prevents the 'incidence of natural selection,' and so gives the species all the time necessary to get the variations required for the full instinctive performance of the function.

III. These positions are illustrated in a very fortunate way by the interesting cases reported by Prof. Morgan in his discussion this evening. He cites the beautiful observation that his young chicks had the instinct to drink by throwing their heads up in the air, etc., but that it came into action only after they had the taste of water by accident or by imitating the old fowl. As Mr. Morgan says, the 'incidence of natural selection' is prevented by the imitation or instruction or intelligent adaptation (in cases where experience is required). So, in this instance, the instinct of drinking, which has only got so far as a connection of certain muscular coördinations with the sense of taste, is made effective for the life interests of the chick. Thus kept alive the species has plenty of time—in case it should be necessary—to get a connection established also between the sight center and the same coördination of movements; so that future chicks may be born with a capacity for drinking when water is seen only without waiting for instruction, a fortunate accident, or an example to imitate. So we may imagine creatures, whose hands were used for holding only with the thumb and fingers on the same side of the object held, to have first discovered, under stress of circumstances and with variations which permitted the further adaptation, how to make intelligent use of the thumb for grasping opposite to the fingers, as we now do. Then, let us suppose that this proved of such utility that all the young that did not do it were killed off; the next generation following would be intelligent or imitative enough to do it also. They would use the same coördinations intelligently or imitatively to prevent natural selection getting its operation; and so instinctive 'thumb-grasping' might be waited for indefinitely by the species and then be got altogether apart from use-inheritance.

We may say, therefore, that there are two great kinds of influence, each in a sense hereditary; there is *natural heredity* by which variations are congenitally transmitted with original endowment, and there is '*social heredity*' by which functions socially acquired (*i. e.*, imitatively, covering all the conscious acquisitions made through intercourse with other animals) are also socially transmitted. The one is phylogenetic; the other ontogenetic. But these two lines of hereditary influence are not separate nor uninfluential on each other. Congenital variations, on the one hand, are kept alive and made effective by their conscious use for intelligent and imitative adaptations in the life of the individual; and, on the other hand, intelligent and imitative adaptation become congenital by further progress and refinement of

* That they are really the same in type and origin I have argued in detail in my work *Mental Development in the Child and the Race* (2d ed., Macmillans, 1895).

variation in the same lines of function as those which their acquisition by the individual called into play. But there is no need in either case to assume the Lamarckian factor.

The intelligence holds a remarkable place in each of these categories. It is itself, as we have seen, a congenital variation: but it is also the great agent of the individual's personal adaptation both to the physical and to the social environment.

The emphasis, however, of the first of these two lines of hereditary influence gives prominence to instinct in animal species, and that of the other to the intelligent and social coöperation which goes on to be human. The former represents a tendency to brain variation in the direction of fixed connections between certain sense centers and certain groups of coördinated muscles. This tendency is embodied in the white matter and the lower brain centers. The other represents a tendency to variation in the direction of alternative possibilities of connection of the brain centers with the same or similar coördinated muscular groups. This tendency is embodied in the cortex of the hemispheres. I have cited 'thumb-grasping' because we can see in the child the anticipation, by intelligence and imitation, of the use of the thumb for the adaptation which the simian probably gets entirely by instinct, and which I think an isolated and weak-minded child, say, would also come to do by instinct.

IV. Finally there are two general bearings of the position taken above regarding the developmental function of intelligence and imitation which may be briefly noted:

1. We reach a point of view which gives to organic evolution a sort of intelligent direction after all; for of all the variations tending in the direction of an instinct, but inadequate to its complete performance, *only those will be supplemented and kept alive which the intelligence ratifies and uses for the animal's personal adaptations.* The principle of selective value applies to the others or to some of them. So natural selection kills off the others; and the *future development of instinct must at each stage of a species' development be in the directions thus ratified by intelligence.* So also with imitation. Only those imitative actions of a creature which are useful to him will survive in the species; for in so far as he imitates actions which are injurious he will aid natural selection in killing himself off. So intelligence, and the imitation which copies it, will set the direction of the development of the complex instincts even on the Neo-Darwinian theory; and in this sense we may say that consciousness is a 'factor' without resorting to the vague postulates of 'self-adaptation,' 'growth-force,' 'will-effort,' &c., which have become so common of late.

2. The same consideration may give the reason in part that instincts are so often coterminous with the limits of species. Similar structures find the similar uses for their intelligence, and they also find the same imitative actions to be to their advantage. So the interaction of these conscious factors with natural selection brings it about that the structural definition which represents species, and the functional definition which represents instinct, largely keep to the same lines.*

J. MARK BALDWIN.

PRINCETON UNIVERSITY, February 5, 1896.

* In conversation with Prof. Lloyd Morgan I was glad to find that he was inclined to interpret the facts which I have quoted from him (and others) in somewhat the same way—that is, as pointing to general conclusions similar to those reached above. While I have reached my conclusions quite independently and from a psychological point of view, any confirmation which they get from so expert and eminent a biologist gives them much greater weight.

INSTINCT.

EDITOR OF SCIENCE: Some remarks appended to my letter published in SCIENCE No 62, on the subject of Prof. Morgan's views on instinct by 'The Writer of the Note,' in view of the importance of the subject are worthy of further consideration.

Before drawing conclusions from observations on domestic animals, it is well to consider similar facts in connection with their wild congeners, especially if such conclusions are of a far-reaching character, and it cannot be too well borne in mind that our experiments are very clumsy imitations of nature in a large proportion of cases.

If food be set down in considerable quantity before newly hatched chicks, and in a vessel similar to that in which water is usually held, they will be relatively slow to recognize and eat such food. But in a wild state the congeners of the domestic fowl, as grouse, pheasants, etc., do not find food or water before them in such way. Their food is distributed, however, much more like the particles we scatter before the chick than does their water supply resemble that of our methods.

A young grouse would naturally get its water from the dew on herbage, possibly from rain water that had gathered in little hollows of the ground, surface, etc. And when the birds approach a stream the surface near is moist or wet, the particles it would naturally peck at would be found up to and beyond the very margin of the water, so that the contact of the beak with water in all these cases would be inevitable and drinking would come about as naturally as eating.

When the 'writer of the note' says, 'A chick swallows water instinctively, but must be taught to drink by example or accident,' the latter term evidently having reference to the observation specially described in my letter, he plainly either misses the real point of my observation or neatly evades it. One might as well say a puppy learns to smell by accident, for in the case in question the chick did not swallow water merely, but raised its head like an old fowl and *drank* perfectly well on the very first occasion that its beak had ever been immersed in water (as a puppy sucks when its lips first come in contact with a teat, etc.); and this I take it is what happens in nature. The young grouse in the forest, or even the chick on a grass plot or in a garden, would come in contact with water without any assistance from the mother bird.

The assumption that 'the chick might die of thirst in the presence of water, as the sight of water does not call up the movements of pecking at it as do food and other small objects,' is purely gratuitous. It is not primarily so much the sight, but rather the touch of water, inevitable, as I have tried to show, in a wild state that in the very first instance leads to drinking, though the bird would also peck at shining dew drops, as my chick did at the drops on the rim of a vessel containing water. With a fair chance and plenty of water about in a condition at all resembling that in nature, there is no such thing for a vigorous, hardy chick as death from thirst.

That habits may be hereditary in dogs I have many times observed in my own kennel during the last eight years, and, without expressing any opinion as to the origin of instincts now, I can see no impossibility in their dating back to habits.

A doctrine which asserts that eating is instinctive, but that drinking is not, is to my mind one to marvel at, and is a poor foundation for theories of evolution or heredity.

Comparative psychology will, I fear, continue to suffer till those who assume to deal with it authoritatively spend more time among animals, and less in their studies. A few observations or experiments do not give them insight into the psychic nature of animals, and it were well, I venture to think, if the qualifications of the comparative psychologist, as set forth by Dr. Groos, in the preface to his admirable work, "Die Spiele der Theire," were thoroughly known and believed in by all psychologists.

WESLEY MILLS.

MCGILL UNIVERSITY, MONTREAL.

PECULIAR ABRASION OF TREE TRUNKS.

PASSING recently through a tract of rather open forest land, I could not help but notice a very peculiar appearance or color showing to a nearly uniform height on the westward side only of many trees of different species.

This shade of dull yellow extended from the surface of the snow to a height of about three to four feet, and at a little distance had much the appearance of a fungoid growth which often may be seen in nearly this color on dead or decaying trees.

At first I was completely deceived, thinking it to be a growth of this nature, and wondering why it should have attacked so many trees at the same time, I proceeded to investigate. A close examination at once revealed the truth of the matter. It was a plain case of wind-carried snow and sleet versus tree trunks, and the outer moss-grown bark had succumbed as its cut and abraded surface made plain. In places this abrasion amounted to almost a polish, at once bringing to mind the published descriptions of the cutting, polishing and sometimes complete destruction of tree trunks in portions of the southwest by flying sand.

To clearly show the entire possibility of the abrasion in this case being due to flying snow or sleet, I would state that the woodland wherein the phenomena was noticed is very open, of scattering growth and constitutes the northwestern border of a forest of small extent, having an open exposure to the westward of upwards of a mile. Thus the prevailing westerly winds, which rage with tremendous severity at times through this open tract, are able during the winter to hurl and sift through this thin forest growth tons of snow and icy sleet. This is evidenced by the enormous snow-banks which yearly form in the forest, at a little distance from its margins, in short, at the point where the wind by meeting repeated resistance loses its carrying power. This line of deposit varies, governed by the surface contour and variable density of forest growth.

Possibly the phenomenon described has been noticed and published before, but having access to considerable literature on forestry, I have never as yet met with any account, hence this slight contribution which may be of interest to some of the readers of SCIENCE.

PERCY M. VAN EPPS.

GLENVILLE, N. Y.

THE PUMA, OR MOUNTAIN LION.

DURING last July and August I was encamped with my family up on the Strait of San Juan de Fuca, near Port Williams, Clallam county, about thirty miles west of Port Townsend. One afternoon, while my children, with their nurse, were playing upon the beach in front of our cabin, a mountain lion (Felis concolor Linn.) came down through a strip of woods to the low bank overlooking the beach, and gave utterance to a most frightful cry or scream. I hastened out, calling loudly, and the commotion made by myself, wife, children and nurse, frightened away the brute. Although I had a Winchester repeating rifle in the cabin, I was unable to attempt to get a shot, by reason of a severe illness with which I had been prostrated for several weeks. I heard this wild cry repeated several times after wards, but each time farther away in the forest.

About two years before a Mr. Travis, a rancher, living near our camp, was returning home after dark, on horseback, and was chased by a lion. The horse fled in terror along the trail through the forest, never stopping until reaching home. Mr. Travis thinks that the attack was incited by a small dog that accompanied him, rather than upon himself or his horse. He returned the next morning to the locality with several hunting dogs and succeeded in shooting the animal, which proved to be a very large specimen, measuring eight feet from tip to tip. The lions are comparatively plentiful in all wild and thinly settled portions of the State.

I have written this sketch at the suggestion of Mr. Frederick W. True, of the Smithsonian Institution, author of an interesting illustrated paper on 'The Puma or American Lion,' published under the auspices of the Institution in 1891. In this paper Mr. True refers to a conflict of authorities in regard to the cries or screams of the animal, and also in regard to its belligerency, or rather, possibly, its timidity.

MERIDEN S. HILL,

Corresponding Secretary, Tacoma Academy of Science.

TACOMA, WASHINGTON, February 13, 1896.

LOGIC AND THE RETINAL IMAGE.

WHILE admitting that *all* the physiological antecedents to the sensation of vision are entirely outside the bounds of our experience in the use of eyes, your correspondent, C. L. F. (SCIENCE, February 7, 1896, p. 201), and many others who have written to this journal on the subject during the last six months, object to my assertion that I find *one* of these phenomena inconceivable; and they treat my statement that I cannot conceive that the image on my retina is upside down, as if I had said that I could conceive of the image if it were anything else than upside down.

If for purposes of illustration I declare my conviction that the moon is not made of green cheese, what are we to think of the 'logic' which interprets this as an assertion that it is made of cheese, although this is not green? I can see no better logical warrant for attributing to me the opinion that I can conceive of the retinal image, but not of its inversion; for, most assuredly, I have said nothing of the sort, and I find all the physiological antecedents to vision equally inconceivable.

If something in the minds of certain writers leads them to believe that I adhere to an obsolete and worthless hypothesis of vision I am helpless, for while I have the right to demand that my words shall pass at their face value I have no way to defend this right except an appeal to unprejudiced readers.

I cannot conceive of the antipodes, and if C. L. F. infers that I accept the astronomy of Homer I must bear up as well as I can.

Both the rotundity of the earth and the inversion of the retinal image are proved by ample evidence, but apprehension of the proof of a truth is a very different thing from conception of the truth itself, and no one who is not totally destitute of imagination could confuse the one with the other; although it may be well to remind C. L. F. that I have nowhere said that 'there is anything which needs explanation in the fact that the image on the retina is inverted,' and that it is because the evidence *is* conclusive that I made use of the inversion to illustrate that great law of logic that '*the test of truth is evidence and not conceivability.*' (SCIENCE, Oct. 4, 1895.)

If any reader cares to ask what has called forth all this criticism, which has occupied the pages of SCIENCE for more than six months, he may be surprised to find that my statement about the retinal image was nothing more than an incidental illustration of less than a dozen words in an article in SCIENCE, October 4, 1895, in which I tried to show that "the mental vice to which we are most prone is our tendency to believe that lack of evidence for an opinion is a reason for believing something else."

The correspondence which this illustration has excited seems to show that I should have done well to state this truth in a more general form, and to point out that the mental vice to which we are most prone is our tendency to interpret a negation as an affirmation of something else.

W. K. BROOKS.

CERTITUDES AND ILLUSIONS.

TO THE EDITOR OF SCIENCE: In my first article on 'Certitudes and Illusions,' I cited two illustrious examples of persons who had lapsed into reification, namely, Spencer in his 'First Principles,' where he reifies force, and Hegel in his Logic where he reifies idea or comprehension; but I did not attempt to exhibit Spencer's reification of force or Hegel's reification of idea. In that article I tried to set forth the nature of the subject-matter of a series of articles which I had planned and promised the editor.

Fichte has seized upon certain of Kant's reifications and those of others and reasoned about non-existent abstractions or pure properties of mind, and in his presentation has naïvely reduced the whole method of reasoning to an absurdity; but he died a disappointed and sad man because he had not consciously discovered that he had murdered his own methods. Hegel seems to have discovered this and to have characterized pure abstraction in no unmeasured terms, notwithstanding which he finally fell into the same vice and reified idea. In my first article Hegel's illusion was not set forth, but only reference made to the matter for the purpose of calling attention to the subject-matter of which I wish to treat. I shall not ignore or underestimate Spencer's contribution to the biology of the lower animals nor his contribution to psychology. In the same manner I shall not underestimate Hegel's acute reasoning in his system of logic, but I shall attempt to show that Hegel accepts Kant's doctrine of antinomies and develops this doctrine into a logic of contradiction and by its use reifies idea and ends as an absolute idealist. Now, Mr. Editor, permit me to say this word in reply to Prof. Royce, whose letter is in every way kind, but whose error consists in supposing that I attributed to Hegel all of the reifications mentioned in my article.

If he will take down the *Phänomenologie des Geistes* and read in the first chapter what Hegel has said about the demonstratives, and then read what I have said about them, he will discover to what I had reference in the treatment and use of these demonstratives, and maybe he will further discover that I have a purpose in speaking of the demonstratives, as I intend ultimately to develop certain doctrines of language most clearly brought out by them.

Since writing the above the managing editor of this journal has kindly forwarded the proof sheets of Prof. Fullerton's article, about which I beg to be indulged in a brief statement.

In my first paper it will be seen that I did not attempt to demonstrate anything; for I said: "In the following chapters an attempt will be made to show that we know much about matter, and although we do not know all, all we know is about matter in its categories of number, extension, motion, duration and judgment, or that we know of matter in its four categories and that we know of mind in the categories of judgment, but always this mind is associated with matter. In doing this we shall endeavor to discriminate between the certitudes and illusions current in human opinion."

I merely attempted to explain the nature of the problems which I designed to discuss and to show that these problems are fundamental to metaphysic and to science alike. To indicate that there are two views of these problems—the metaphysical view and the scientific view—I shall attempt to set forth a series of certitudes and another series of illusions which relate to these certitudes. If I prosper in my demonstration I shall show that the certitudes come from science and that the illusions come from metaphysic. Now it must be understood that metaphysic does not deal wholly with illusions but that fundamental illusions are developed by metaphysical reasoning, and I shall further show that science attempts to deal with certitudes, but often fails by adopting the method of metaphysic and still oftener adopts its illusions. The illusions which I shall attempt to explain will be chiefly illusions of metaphysic, but they will also be illusions of science, because science has not wholly divested itself of metaphysical reasoning. The certitudes which I shall attempt to demonstrate I shall hold myself ready to maintain until my errors are shown; if such errors are demonstrated I shall promptly confess and eschew. I do not know that the man who has published can fully assume this attitude, for in a long life of scientific reading I have discovered that publication is wax in the ears and thus a source of profound deafness to the voice of reason. If Prof. Fullerton will kindly attend to the propositions I shall attempt to demonstrate, he will be able to put me right where I am wrong, and I hope that he will be able to reinforce my certitudes by firmer rings of reasoning.

Professor Fullerton seems to be surprised and agrieved that an anthropologist should express opinions concerning metaphysic. The Professor may be interested to know that anthropology includes metaphysic as one of its themes of study for the purpose of discovering its certitudes and illusions and it sometimes finds in its ancient asphodel fields phantom flowers that turn to ashes when plucked by the hand of science.

J. W. POWELL.

SCIENTIFIC LITERATURE.

Geological Biology; an introduction to the geological history of organisms. By HENRY SHALER WILLIAMS. New York, Henry Holt, 1895. xx+395, pp. 8°. Illustrated.

Prof. Williams tells us that this book was originally written in the form of lectures delivered at Cornell University, which have been rewritten and elaborated so as to be available for use as a text-book as well as an exposition of principles. It has been prepared with a view to its use not only by students, but also the general reader "who is supposed to know something of the present popular theories regarding organic life, and has, perhaps, already become aware of the increasing sense of disappointment which those are meeting who have attempted seriously to apply them to the solutions of the problems of human life." It is not assumed that the reader has any special knowledge of biology or geology, and therefore many details are entered upon which would be superfluous for the specialist. "In defining our topic as geological biology we are not proposing to investigate the anatomical organs and tissues of which particular animals are made, but to review the facts and theories which have led to the belief that each living animal and plant is but the last of a long line of organisms whose remains can be recognized in more or less perfect fossils and whose varying characters can be traced back into the immense antiquity of geological time" (p. 3). "The history of organisms which we particularly trace in the study of fossils is not the history of imperfect organisms struggling toward perfection, but it is the history for each age and epoch of the perfected adjustment of the organisms of the time to the particular conditions of environment in which they lived. They did not die before their time, overcome by the mythical fittest who are said to survive in the struggle. They were the fittest and died natural deaths, having provided, before they gave up the struggle for their progeny, to succeed them. The hard parts record the history of adults which had endured the struggle, and thus represent the royal line of succession for the geological ages" (p. 81).

The book opens with a discussion of the history of organisms and its geological aspect. The second chapter gives an excellent and interesting summary of the history of geology, which is followed by a discussion of the geological time-scale, and of the nature, nomenclature and fossil contents of stratified rocks, geographical distribution, the nature and origin of species, the acquirement of characters, intrinsic and extrinsic, their plasticity and permanency. The rate of morphological differentiation and progressive modification are considered at length and illustrated by the history of selected types. The final chapters treat of the laws of evolution as illustrated by the geologic history of organisms and the philosophical conclusions drawn therefrom.

The author concludes that "the Animal Kingdom is divisible into a number of definite groups marked by definite organization, all the grander features of which were outlined in the Cambrian age, and the large majority of all the differentiations of even ordinal rank had been accomplished in the first quarter of the recorded history of organisms," hence the laws of evolutional history must be read in terms of the minor groups. As emphasized by fossils these laws include an orderly succession of increasing differentiations in organic structure which we call evolution; certain parts of each organism exhibit the progress of evolution more rapidly than other parts, the characters of least structural importance showing the most constant and steady but slow differentiation, while the characteristics of higher rank are relatively more rapid in their initial development and subsequently very constant in each successive generation. These two tendencies are expressive of the two fundamental laws of heredity and variability, and the process of evolution is the combined result of their interaction. The mode of evolution consists in the acquirement of new characters by variation and in the acceleration or retardation of development of characters already required. The causes of evolution are extrinsic or intrinsic, the former being of the nature of an adjustment to the environment direct or selective; the latter "acts previous to the individual birth and seems to be at the foundation of variability. The mode and manner of expression of this kind of evolution are more difficult to define than in the case of extrinsic evolution, but the facts of paleontology clearly indicate that such a cause exists prior to the morphological appearance of each individual and species" (pp. 369–70).

"The great facts attested by geology," according to Prof. Williams, "are that the grander and more radical divergencies of structure were earliest attained; that, as time has advanced, in each line intrinsic evolution has been confined to the acquirement of less and less important characters; such facts emphasize with overwhelming force the conclusion that the march of the evolution has been the expression of a general law of organic nature in which events have occurred in regular order, with a beginning, a normal order of succession, a limit to each stage, and in which the whole organic kingdom has been mutually correlated. * * * So were we to lengthen out the gyration of organic plastidules or biophores, a million million years, continuously holding on to their original powers and potencies for all that time, we are not relieved in the least from the logical necessity of endowing them at the outset with the real directive energy which phenomenally expresses itself for the first time when the finally adjusted organism appears. And the increment to organic structure expressed by their final bursting into morphological reality after travelling unobserved but potential through the organic matter of countless generations is as much a result of creative energy as if a new species were to arise out of the dust of the earth" (pp. 380–382).

It is of course almost impracticable by means of isolated paragraphs to give any adequate impression of a whole volume of observation and discussion with a wealth of varied illustration. But we shall not go far astray, perhaps, in summing up Prof. Williams' attractive book as in great part a restatement, in terms of evolution, of the argument for design in nature.

W. H. D.

WINGE ON BRAZILIAN CARNIVORA.

IN a recently published quarto of 103 pages* Mr. Herluf Winge gives the results of his studies of the extensive collections of Carnivora made near Lagoa Santa, province of Minas Geraes, southeastern Brazil, by Lund, Reinhardt and Warming, and now in the Zoölogical Museum at Copenhagen. The material thus brought together owes its peculiar interest to the fact that it consists partly of the remains of living animals and partly of bones and teeth from the earth deposits of the caves with which the region abounds. It is thus possible to compare the present fauna with the extinct fauna of which it is the immediate successor. As the author remarks (p. 79), the South American fauna is poorer in Carnivora than that of any other region except Australia. The latter was, however, probably isolated before the appearance of the order. While Lagoa Santa is, for a South American locality, remarkably well provided with Carnivora,† the group is represented by only four families, ten genera and twenty-five species. These the author arranges as follows:

FELIDÆ: *Felis tigrina*, *F. macroura*, *F. eira*, *F. concolor*, *F. onca*, *Machærodus neogæus*.

URSIDÆ: *Canis azaræ*, *C. vetulus*, *C. cancrivorus*, *C. jubatus*, *C. troglodytes*, *Icticyon pacivorus*, *I. venaticus*, *Ursus brasiliensis*, *U. bonariensis*.

PROCYONIDÆ: *Nasua narica*, *Procyon ursinus*, *P. cancrivorus*.

MUSTELIDÆ: *Galictis barbara*, *G. intermedia* (= *G. allamandi*), *G. vittata*, *Thiosmus suffocans* (= *Conepatus mapurito*), *Lutra platensis* (= *L. paranensis*), *L. brasiliensis*.

Twenty-three of these are found in the cave deposits ('jordfundne'), while eighteen are found living in the vicinity ('nulevende'). Two species, *Procyon cancrivorus* and *Lutra brasiliensis*, now occurring near Lagoa Santa, have not yet been detected among the cave remains. As the author remarks, however, this can scarcely be taken as evidence that the animals have recently appeared in the region. Among the Carnivora whose remains are found in the caves are six extinct species, and one, *Canis azaræ*, which though now widely distributed through South America, has not yet been taken at Lagoa Santa. The extinct species are *Machærodus neogæus*, *Canis troglodytes*, *Icticyon pacivorus*, *Ursus brasiliensis*, *U. bonariensis* and *Procyon ursinus*. *Machærodus neogæus* is one of the most highly developed as well as one of the largest members of its genus. It is also one of those which have most recently become extinct. The Copenhagen museum contains numerous remains of this animal from La Plata. These, however, do not differ from the Lagoa Santa bones in any essential way. The two closely related bears, *Ursus brasiliensis* and *U. bonariensis*, are in some respects more primitive in structure than other species of *Ursus*. They form, together with *Ursus simus*, a section or subgenus which is extinct, and as yet is known from South America and California only.*

Icticyon pacivorus is closely related to the recent *I. venaticus*. It is more primitive than the latter, of which it appears to be the direct ancestor. *Canis troglodytes*, also one of the extinct species, has much the same general form as the Old World *C. alpinus*. A detailed study of its

*Jordfundne og nulevende Rovdyr (Carnivora) fra Lagoa Santa, Minas Geraes, Brasilien. Med Udsigt over Rovdyrenes indbyrdes Slægtskab. Af Herluf Winge. Aftryk af 'E. Museo Lundii,' en Samling af Afhandlinger om de i Brasiliens Knoglehuler af Professor Dr. P. W. Lund udgravede Dyre og Menneskeknogler. Paa Carlsbergfondets Bekostning udgivet ved Professor Dr. C. F. Lütken, Kjöbenhavn, 1895.

† *Bassaricyon*, *Cercoleptes*, *Lyncodon* and *Mustela* are the only genera, except perhaps a few now extinct, known to occur in South America, that have not yet been detected there.

*See Cope, American Naturalist, XIII., p. 791, 1879, and ibid., XXV., p. 997-999, pl. XXI., 1891.

characters show, however, that it is in no way closely related to *C. alpinus*, but, on the contrary, is a special offshoot from some South American dog of the ordinary type. *Procyon ursinus*, while showing certain characters which prove it to stand nearer the ancestral stock than do the existing species, is considerably larger than any of the latter.

Turning now to the living Carnivora, Mr. Winge gives very extended and elaborate discussions of the specific characters and of the individual variation in both size and color of most of the forms represented in the collection. While the author's tendency to reduce the number of species to the minimum must detract from the critical value of this part of the work, the facts recorded will be of the utmost use to all workers on South American mammals. The discussions of the species of *Felis* and *Canis* are especially important.

For the most part the bones found in the caves agree perfectly with those of the living representatives of the various species. There are, however, a few exceptions to this rule. Thus, only a few of the cave remains of *Felis onca* are of the same size as those of the ordinary existing Jaguar. Most of them represent animals which were about the size of *F. tigris*. There is scarcely any difference in the teeth, but in the bones the discrepancy is very noticeable. Although the cave Jaguars average much larger than those now living, one of the latter occasionally fully equals the largest of the former. The single perfect skull of *Icticyon venaticus* from Lapa dos Tatus differs remarkably from recent skulls of the same species. The nasal bones are much more produced both before and behind, while the whole skull is larger; the rostrum is considerably broader in proportion to the brain case, and the zygomatic arches are more flaring posteriorly. If the differences between this skull and that of the recent specimen as figured on plate V. are in no way due to age and sex, few mammalogists would hesitate to separate the animals specifically. Mr. Winge, however, does not consider such a course advisable, though he admits that the Lapa dos Tatus skull may represent a 'geological race' ('men maaske er det en geologisk race').

As the result of his studies of the interrelationships of the Carnivora in general, Mr. Winge gives the following table of super-generic groups (p. 46, 47).

- Carnivora primitiva.
  - Hyænodontidæ.
    - Proviverrini.
    - Mesonychini.
    - Hyænodontini.
  - Arctocyonidæ.
- Carnivora vera.
  - Herpestoidei.
    - Amphictidæ.
    - Palæonictidæ.
    - Felidæ.
      - Felini.
      - Machærodontini.
    - Viverridæ.
      - Viverrini.
      - Herpestini.
    - Hyænidæ.
  - Arctoidei.
    - Ursidæ.
      - Canini.
      - Ursini.
    - Procyonidæ.
      - Mustelidæ.
      - Mustelini.
      - Melini.
      - Lutrini.
    - Otariidæ.
      - Trichechini.
      - Otariini.
    - Phocidæ.

This arrangement differs in many details from that recently adopted by Flower and Lydekker.* The latter authors divide the order into fifteen families and one hundred and six genera, while Winge recognizes the same number of genera and only twelve families. Perhaps the most noticeable peculiarity of the present classification is the treatment of the bears, dogs and raccoons. The two former, or the families *Ursidæ* and *Canidæ* of Flower and Lydekker and of Zittel,† are here treated as subfamilies of the family *Ursidæ*, while the *Procyonidæ* are kept distinct. *Canis* and *Icticyon* are thus brought close to *Ursus*, while *Procyon* is placed in a different group.

* Mammals Living and Extinct, 1891.

† Handb. der Palæntologie, Mammalia, 1892–1893.

In matters of nomenclature, Mr. Winge, as usual, disregards the chief laws through the strict application of which stability of names is alone to be reached. He either believes that uniformity in the use of generic and specific names will best be brought about by allowing the individual preference of each writer full play, or else he takes the less optimistic ground that such uniformity is unattainable and therefore not worth striving for. Be this as it may, a casual examination of the names used in the present paper shows that the author prefers *Galictis intermedia* Lund 1843 to *G. allamandi* Bell 1841, *Lutra platensis* Waterhouse 1839 to *L. paranesis* Rengger 1830, *Thiosmus* Lichtenstein 1838 to *Conepatus* Gray 1837, *Rhizæna* Illiger 1811 to *Suricata* Desmarest 1804, *Mydaon* Gloger 1841 to *Mydaus* Cuvier 1821. He also uses the untenable names *Bassaris*, *Ælurogale* and *Enhydris*, although they have been replaced by *Bassariscus*, *Ailurictis* and *Latax*, respectively. It is difficult to understand why *Trichechus* Linnæus 1758 based on the Florida Manatee should be preferred to *Odobenus* Brisson 1762 as the generic name for the Walrus. Yet *Trichechus* and its derivative *Trichechini* are both adopted by Mr. Winge.

Like the earlier papers of this series* the present work is divided into three main parts: (1) nominal lists of the species; (2) detailed accounts of the species with critical notes on their relationship; (3) a review of the mutual interrelationships of the members of the group at large. To the present paper is appended a table showing semi-graphically the changes that take place in the fifth, fourth, third and second of the original seven cheek teeth throughout the genera of Carnivora (p. 100–103).

The paper is illustrated by eight plates from photographs of specimens. Although the results obtained by photographic processes are not yet sufficiently uniform to meet all requirements the figures are in general satisfactory, especially some of those on plates three, five and eight. GERRIT S. MILLER, JR.

*Mr. Winge has already published in 'E. Museo Lundii' accounts of the rodents, bats, marsupials and monkeys of Lagoa Santa. His paper on the monkeys was noticed in SCIENCE, N. S., II., No. 50, December 13, 1895.

Ethnology. By A. H. KEANE, F. R. G. S. 1 vol. 8vo. Illustrated. Pp. 442. Cambridge University Press. 1896. Macmillan & Co., New York.

The above work is one of the 'Cambridge Geographical Series' published under the general editorship of Dr. F. H. H. Guillemard. The author takes 'ethnology' in its ancient and now generally obsolete sense, nearly synonymous with 'anthropology,' as employed in modern science. Following this definition, he divides his volume into two parts, 'fundamental ethnical problems' and 'primary ethnical groups.' Under the former he discusses such questions as man's place in the animal kingdom, tertiary and quaternary man, the growth of mind and the study of the brain in relation to thought, the antiquity of the human race, the palæolithic and neolithic ages, the theories of polygeny and monogeny, the physical and mental differences of races, their languages and social regulations.

Under the second heading the author's theory of races or groups is presented. It is a modern recast of that of Blumenbach, retaining even his inappropriate term 'Caucasian' for the white race. The other are the Ethiopian, Mongolian and American races; the Malayan race being explained away as partly Ethiopic, partly Caucasic. Of these he undertakes to give the divisions and subdivisions from such authorities as he has consulted.

The manner in which this task has been accomplished will give satisfaction to the general reader. Many questions which the student of the science must consider as still pending, Mr. Keane disposes of with a magisterial decision. He rarely presents the opposing evidence in its proper strength, and refers to those with whom he disagrees as 'eccentric,' or 'reckless,' or "extravagant,' or by other disparaging adjectives. He does not hesitate to strain a point to defend his opinion (*e. g.*, p. 34, Virchow's judgment of the Neanderthal skull), and, it would seem, cannot certainly have remembered some of the authors whom he quotes, or he would not claim as original with himself (p. xiv.) such theories as the local evolution of American cultures, the peopling of America from both Europe and Asia, the relationship of Basques and Berbers, etc. Whether true or not, these are certainly not new views to one acquainted with the current literature of the science.

The relationship of the members of the various races is shown by 'family trees,' an ancient and necessarily misleading device. Thus, his tree of the 'homo Caucasicus' puts the Greeks, Celts and Etruscans on one of its primary branches, along with Circassians and Dravidas, while the Teutons and Slavs are on a different branch! That on this tree are placed the Samoans, Hawaians, Battaks and Khmer is to be explained by the author's theory of the Malayan race above referred to, which he claims and which we may allow is at present, and is likely to be, his own peculiar property.

The tree of the 'homo Americanus' becomes a mass of inconsistencies so soon as he leaves the protection of Major Powell's linguistic map. Even within its area the Kolosch and Selish are depicted as proceeding from the Eskimo! The chapter on the American race is replete with positive assertions, nearly always unsupported, for instance, the imaginary distribution of two types of skull (p. 362), the alleged impassiveness of the native character (p. 353), the 'undoubted' approximation of the American to the Mongol type, etc. It is obvious that the author has not consulted the best and most recent studies in American aboriginal ethnography; yet his chapter might have been much more uninstructive than it is.

The proof-reading is generally satisfactory, though probably a highly respected American writer will not think so when he sees himself referred to as 'Mr. Thomas Cyrus' (p. 370).

Of ethnology proper, in the sense in which it is now adopted by the leading German, French and American writers, the volume scarcely treats at all, and we may look in the Index in vain for the names of Bastian, Post, Steinmetz, Achelis, or the other distinguished representatives of that comparatively new and grand department of learning; and while Mr. Keane's book can be recommended as an industrious compilation, useful to public libraries and well put together, the warning should be distinctly uttered that its title is an error and that it bears scarcely at all on the science of ethnology.

D. G. BRINTON.

Las rocas eruptivas del suroeste de la cuenca de México. EZEQUIEL ORDOÑEZ. Boletin del Instituto Geológico de México. No. 2. México, 1895. Pp. 46.

The contents of the first bulletin of this series were briefly noted in SCIENCE, Vol. II., pp. 739–740. In this issue, Señor Ordoñez presents a very clear description of the important volcanic district of the valley of Mexico, and particularly of the volcanic group of Santa Catarina and of the volcanic rocks of the Sierra de las Cruces. Fourteen opening pages are devoted to giving an 'Idea general de la cuenca de Mexico.' The remainder of the paper, largely petrographic, gives a detailed account of the cones, lava flows, breccias and ashbeds of the southwestern part of this region of andesites, trachytes and intermediate petrographic types.

J. B. WOODWORTH.

SCIENTIFIC JOURNALS.

THE ASTROPHYSICAL JOURNAL, FEBRUARY.

THE leading article is by Prof. L. E. Jewell, upon the coincidence of solar and metallic lines and upon the appearance of lines in the spectra of the electric arc and the sun. When compared with corresponding solar lines, the metallic lines of the arc spectra have been found to be almost invariably displaced toward the violet. There is, moreover, a difference in the amount of displacement of lines belonging to the same element; the greatest shift being observed in the strongest lines.

An explanation for this was sought in the difference between the condition of matter in the arc and in the solar atmosphere. This difference is probably that of pressure or density of material and temperature, or both.

The lines least displaced were those not easily reversed and visible only at a high temperature or when a large amount of material was used. As the solar lines agree most nearly with the lines produced in the center of the arc, where the temperature and density are high, we have the means of determining the pressure or the temperature of the solar atmosphere, where the Fraunhofer lines are produced, if we can separate the effects of temperature and pressure.

Several lines of investigation lead to the conclusion that the wave-length is affected little, if any, by changes of temperature.

The effect of pressure and amount of material used, is discussed in the next article by W. J. Humphreys and J. F. Mohler. Their results corroborate those of former investigators, that an increase of the quantity of material in the arc generally produces a slightly unsymmetrical broadening towards the red, and that increased pressure causes a similar effect; but they find in addition that, upon the application of pressure, a decided shift of the lines toward the less refrangible portion of the spectrum takes place, not due to broadening.

The change in the case of any one element is approximately proportional to the wave-length and to the excess of pressure above one atmosphere. Whether the same law holds for very low pressures could not be determined. The shift for different metals at a pressure of fourteen atmospheres often amounted to from five to ten hundredths of an Ångström unit.

Theoretical considerations indicate that the shift is inversely proportional to the absolute temperature of the melting point. There is, besides, a connection between the shifts and the atomic weights.

A third paper, by the authors of the first two, contains a discussion of the effect of pressure upon the reversing layer of the solar atmosphere. Assuming the atmosphere to be quiescent and the shifts to be due to change of pressure only, they find the pressure of the reversing layer to vary from two to seven atmospheres, according to the weight of the element observed. This seems to indicate that the upper limits of the reversing layers of the different elements are arranged somewhat in the order of their atomic weights.

THE AMERICAN GEOLOGIST, MARCH.

Biographical Sketch of Charles Wachsmuth: By C. R. KEYES. Dr. Wachsmuth was known as the foremost authority on fossil crinoids in America, if not in the world. He spent most of his life in Burlington, Iowa, where he first acquired an interest in crinoids and where he died on February 7, 1896, in his sixty-seventh year. The sketch is accompanied by a portrait.

The Structure of Certain Paleozoic Barnacles: By J. M. CLARKE. The genus of fossil barnacles called *Lepidocoleus*, which occurs in the lower and upper Silurian and lower Devonian, is shown to be a primitive and unmodified type of cirripede structure, consisting of but two vertical ranges of plates, both series terminating in a single plate which is axial and caudal. The dorsal margin of the body is closed by the interlocking of the plates, but the ventral margin is closed only by their apposition and was dehiscent for the protrusion of the appendages.

The Mineral Deposits of Eastern California: By H. W. FAIRBANKS. The ore deposits discussed are chiefly those of gold and silver, the occurrence of the former being treated in considerable detail. The gold-bearing quartz veins are considered as unquestionably of fissure origin, and the contents of these veins bear no particular relation to the mineral composition of the country rock.

Note on the Discovery of a Sessile Conularia—Article I: By R. RUEDEMANN. The author has found in the lowest part of the Utica shale some specimens of *Conularia gracilis* Hall, to which are attached peculiar cuneiform fossils, and he has also found similar forms on two specimens of the shell of *Trochonema*. Evidence is presented to show that these peculiar forms are the young of *C. gracilis*, as is also the so-called plant, *Sphenothallus angustifolius* Hall. These young individuals of *Conularia* were not free but attached, and it is probable that the adult forms were also sessile, although attached adult specimens have not yet been found.

A New Titanichthys: By E. W. CLAYPOLE. The new form is much smaller than the other species of the genus and is named *Titanichthys brevis*. It was found by Dr. Clark, who has discovered so many fossil fish in the Devonian of Ohio.

Thickness of the Paleozoic Rocks in the Mississippi Basin: By C. R. KEYES. The estimate made by various geologists of the Paleozoic rocks of the Mississippi basin are given, and attention is called to the fact that the estimates of later years are considerably lower than the others. A recent deep boring at Kansas City, which is in the region of greatest thickness of the Paleozoic, has passed through the entire (with the exception of a part of the upper Coal measures) Paleozoic column, and entered mica schist, which is regarded as Archean in age. Estimates from this boring give about 3,000 feet as the total thickness of the Paleozoic.

Microscopic Characters of the Fisher Meteorite (Minnesota No. 1): By N. H. Winchell. This meteorite fell in Polk County, in northwestern Minnesota, April 9, 1894. It is a chondritic stone made up largely of olivine and enstatite, and contains a comparatively small amount of iron. Two apparently isotropic substances occur in the meteorite, one of which may be maskelynite; but the conclusions concerning these substances and the chemical composition of the stone will be discussed in a later paper.

The number closes with the usual reviews and notes. Of special interest, however, is the review of Nordenskjöld's important paper on the Swedish hälleflintas, largely pre-Cambrian lavas. In this review are some interesting remarks concerning the devitrification of glass, and reference is made to some phenomena of devitrification recently observed at Bryn Mawr College.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON, FEBRUARY 29, 1896.

Dr. J. Walter Fewkes read a communication on the Prehistoric Culture of Tusayan. He regarded archæology as the only means of obtaining accurate knowledge in regard to the subject, and considered documentary history, study of surviving legends and modern practices as tributary and necessary sources of information. Archæological evidences of the character of ancient life in Tusayan were drawn from excavations at Sikyatki, a ruined pueblo near Walpi, which was investigated by an expedition sent out last summer by the Smithsonian Institution under the lead of the speaker. The material unearthed from this ruin was a large collection of pottery of rare excellence and many objects illustrative of prehistoric Tusayan industries.

The evidences that Sikyatki was overthrown previous to the coming of the Spaniards into Tusayan in the middle of the sixteenth century were discussed, and shown to amply prove that the pueblo was destroyed in prehistoric times. The great value of the objects from this ruin was therefore held to be that they indicate prehistoric culture, without European influences. The ceramics of Sikyatki are far superior to modern Tusayan pottery, and excel in fineness of ware, symmetry of form and artistic beauty of decoration those of any aboriginal tribe of America north of Mexico.

The reason of the fineness of this ware and the possibility that coal was used in firing it were discussed. The identity of prehistoric and modern mortuary customs, as indicated by the objects taken from Sikyatki graves, was interpreted to mean a similarity of ancient conceptions of death and a future life. Current modern beliefs on this subject were discussed and applied to an interpretation of ancient customs.

It was held by the speaker that the symbolic designs on this ancient pottery should be considered a body of prehistoric picture writing or paleography, and that the aim of the student should be to interpret it. He likened this symbolism to ancient records, and claimed that from them could be obtained a knowledge of mythological conceptions and ancestral rituals. The pictures of several animistic and other gods still recognized in modern Tusayan mythology were instanced and compared with modern figures. This ancient pictography likewise shows the antiquity of peculiar methods of dressing the hair.

The resemblance of certain geometric designs to those on the pottery from the great ruins of the Gila valley and the cliff dwellings of the Mesa Verde was pointed out and the importance of such likeness discussed.

Dr. Fewkes spoke of a large number of mortuary prayer-sticks or pahos in Sikyatki graves, which he compared with modern and found a great conservatism in their form, size, color and appendages. He believed these resemblances meant a similarity in ancient and modern conceptions of the priests who made them. The existence of other ceremonial paraphernalia, identical with those still used in the modern Tusayan ritual, was likewise pointed out. A knowledge of modern mythology and ritual he regarded as necessary for anyone who would do good work on the archæology of the Southwest.

He showed that in prehistoric times the Tusayan people had Oliva shells from the Pacific Ocean and turquoises from New Mexico. They were ignorant of any metal, but were adepts in stone chipping and polishing. Fabrics were made from the feathers of the bluebird and eagle, and they had necklaces of cedar berries, turkey bones, with ornaments of lignite, selenite and mica.

He brought forward additional evidence to show the identity of cliff dwellers and ancient pueblos and considered that some of the cliff houses were inhabited when Sikyatki was in its prime. In closing Dr. Fewkes emphasized the poverty of material in museums from which we could draw evidences for speculations in regard to the derivation of prehistoric pueblo culture, and held that theorizing had far outstripped observation. While considering science piteously weak in data, he thought that no field offered more promising results to a serious student than the ruins of the Southwest.

The second paper was on *a new solution of the geodetic problem*, by CHAS. H. KUMMELL, of U. S. Coast and Geodetic Survey. This solution is based on the geodetic line. It requires therefore a reduction of the astronomical azimuth to the geodetic azimuth and, theoretically at least, a reduction of the astronomical latitude to the reduced latitude. An auxiliary spherical triangle is assumed, having the equation of the geodetic line for its sine relation, which is referred to that point as origin where it meets a meridian at right angles. The distance in arc of the first point from that meridian is denoted δ, that of the second $\sigma_2 = \sigma_1 + \Delta\sigma$. The arc σ_1 is easily computed, and $\Delta\sigma$ is found from a series of which only three terms are required even for the greatest intervisible distances. We have now in the auxiliary spherical triangle the sides $\Delta\sigma$, $90° - \psi_1$ (complement of reduced latitude of first point), and included angle a_1 (geodetic azimuth to second point). We can find then by rigorous spherical trigonometry the parts a_2 and $90° - \psi_2$ and hence also the astronomical back azimuth a_2 and latitude ϕ_2. To attain the customary precision this would require ten-place logarithms. In order to reach the same accuracy with seven place logarithms formulæ are given for computing the convergence of meridians Δa and difference of latitudes $\Delta\phi$. For $\Delta\lambda$, the difference of longitudes, two methods are given, one based on the geodetic line by computing $\Delta\lambda_0$, the angle opposite the side $\Delta\sigma$ and correcting this, by a term of the fourth order in eccentricity and first order in distance. The other method is by Dalby's theorem and is more convenient. A complete example computing the position of Königsberg from Berlin was exhibited, which showed the formulæ used as precise as the ten-place computation of the same example in Helmert's Hoehere Geodæsie. The method is claimed to be principally advantageous for the greatest intervisible distances for which e and $\Delta\sigma$ are nearly of the same order (they are equal at about $500{,}000^{m}$). For secondary points $\Delta\sigma$ is much smaller than e and in that case Tables and Formulæ such as Woodward's Smithsonian Geographical Tables and those of the Coast Survey which go an order higher are preferable.

BERNARD R. GREEN,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 115th regular meeting was held March 5, 1896.

Mr. Marlatt, under the title 'A Study of the Anatomy of Hymenoptera,' gave a comprehensive view of certain structural features of Tenthredinidæ, dwelling at length upon the homologies of the sclerites of the thorax.

Mr. Schwarz, under the head 'Notes From Southwestern Texas, No. 2,' spoke of a species of Termite which is found in great numbers throughout southwestern Texas, which burrows deeply under the ground and which is of great economic importance from the fact that during a large part of the summer it destroys all low-growing vegetation in large patches, rising from the ground and enclosing all portions of the plants with a tubular structure composed of grains of subsoil. The insect is probably the worst insect pest of southwestern Texas, on account of the damage which it does to pasturage.

Mr. Ashmead exhibited a specimen of a new species of Roctronia of Provancher. The species in question comes from California, and by its aid Mr. Ashmead has decided that this genus belongs to the subfamily Helorinæ of the Proctotrypidæ.

L. O. Howard,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES—BIOLOGICAL SECTION, FEBRUARY 7, 1896.

Dr. J. G. Curtis in the Chair.

A communication from the Council was received asking that the Section take action on Representative Hurley's bill "To fix the standard of weights and measures by the adoption of the metric system of weights and measures."

On motion of Dr. Dean the Section approved the bill, and the Secretary was directed to express the entire commendation of it to the Council.

Dr. Arnold Graf read a paper on 'The Structure of the Nephridiap in Clepsine.' He finds in the cells of the intra-cellular duct fine cytoplasmic anastamosing threads which form a contractile mechanism. These are stimulated by granules which are most numerous near the lumen of the cell, and thus a peristalsis is set up, which moves the urine out of the duct. In the upper part of the intra-cellular duct the two or three cells next to the vesicle or funnel have no distinct lumen, but are vacuolated; the vacuoles of the first cell being small, those of the second larger, and so on, till the vacuoles become permanent as a lumen. He explains the action of the first cell as being similar to the ingestion of particles by the infusorians. The matter taken up thus from the funnel by the first cell is carried by the rest, and so on till the cells having a lumen are reached. The presence of the excretum causes the granules to stimulate the muscular fibres of the cells; peristalsis results and the substance is carried outwards. The character of this contractile reticulum offers an explanation of the structure of a cilium as being the continuation of a contractile reticular thread.

N. R. Harrington, in 'Observations on the lime gland of the Earthworm,' described the minute structure of these glands in L. terrestris, and showed that the lime is taken up from the blood by wandering connective tissue cells which form club-shaped projections on the lamellæ of the gland, and which pass off when filled with lime. The new cell comes up from the base of the older cell and repeats the process. This explanation is in harmony with the fact that in all other invertebrates lime is laid down by connective tissue cells. Histological structure and the developmental history confirm it.

Dr. Bashford Dean offered some observations on 'Instinct in some of the lower Vertebrates.' The young of Amia calva, the dogfish of the Western States, attach themselves, when newly hatched, to the water plants at the bottom of the nest which the male Amia has built. They remain thus attached until the yolk sac is absorbed. As soon as they are fitted to get food they flock together in a dense cluster following the male. When hatched in an aquarium they go through the same processes. The young fry take food particles only when the particles are in motion, never when they are still. The larvæ of Necturus also take food particles that are in motion.

C. L. Bristol,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

At the meeting of the Section of Astronomy and Physics held on March 2, 1896, the election of officers for the ensuing year was held, and R. S. Woodward was elected Chairman and W. Hallock Secretary.

The first paper of the evening was upon the device designed by Prof. W. L. Robb for showing the way in which a cord can vibrate, consisting essentially of an electro-magnet running a vibrating arm to the end of which the string is attached.

The second paper was upon a new form of polariscope, designed by Prof. A. M. Mayer, consisting of a special arrangement of crossed lenses, resulting in unusually good illumination and large field.

The next paper was upon a heliostat designed by Prof. Mayer. In this connection Prof. Mayer called attention to the shortcomings of the various forms of heliostats, and especially those using only one mirror, pointing out, among other things, the useless width of mirrors on such heliostats, and illustrating what ought to be the dimensions of such a mirror. He also called attention to the great advantage of using sunlight for all optical experiments over any form of electric light; for example, with a heliostat and condensing system he was able to project the interference bands of the Fresnel bi-prism upon a screen so that they were visible across a large room. Prof. Mayer's heliostat consists in a clockwork driving a shaft parallel to the earth's axis; upon the southern end of the shaft is the mirror that can either be twisted on the shaft or set at any angle to the shaft. The second mirror is mounted upon the base with its central point in the prolongation of the shaft. To orient the heliostat it is only necessary to bring the side pieces in the north and south line and then set the mirror on the clock axis. This last is done by covering the elliptical mirror with a paper having a ½-inch hole in the center, and adjusting the tilting mirror until the small beam of light reflected from the mirror through the hole falls upon the center of the mirror attached to the base of the instrument; then starting the clock, the instrument will keep the beam in a constant direction. Prof. Hallock in discussing the paper called attention to the accuracy with which the heliostat operated, and related his experience with a very large one-mirror heliostat in the Smithsonian Institution at Washington, which, however, was thoroughly unsatisfactory. Prof. Woodward and Prof. Jacobi also entered into the discussion of the relative merits of the various heliostats, especially the typical one-mirror and two-mirror heliostats.

Prof. M. I. Pupin then brought before the academy some recent observations he had made while experimenting with X-rays. In the first place, he pointed out that certain Crooke's tubes after a certain amount of use had their vacuum improved, so that the induction spark passed outside the tube rather than through the tube. Prof. Pupin was at a loss to altogether explain the cause, but believed that it might be due to the condensation of some of the gas remaining in the tube, and explained several experiments which he had already made confirming the observation that the vacuum was improved with use, and that in proportion as the vacuum improved the tubes were better for X-ray photography. Another phenomenon observed by him was that in developing the photographic plates the development began at the glass side of the film, leading to the inference that the X-rays penetrated the film and rendered the glass fluorescent, this fluorescent light then acting upon the film. Following the suggestion of this observation he painted the inside of a box with the platinum-barium-cyanide and laid a photographic plate against it, making a photograph then through the side of the box. The X-rays develop the fluorescence in the cyanide which fluorescent light affects the plate. In this way he obtained very good results with much shorter exposures than by the original method.

W. HALLOCK,
Secretary of Section.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held February 19th, thirty persons present. Mr. A. W. Grabau showed a specimen of the broad variety of Paradoxides harlani Green from a third locality in South Braintree.

Prof. A. Hyatt called attention to several shadowgraphs taken in Germany by Mr. R. W. Wood. One of them shows plainly the bones, the position and outline of the lungs, heart and œsophagus of a mouse, and indicates the possibilities of the ray as an aid to natural history studies.

Mr. Outram Bangs read a paper on the terrapin (*Malaclemys terrapin* Schœff) as an inhabitant of Massachusetts. This species has been known for fifteen years as occurring in the creeks and salt marshes of Buzzard's Bay. It was formerly very abundant, but has lately become quite scarce. A comparison of the Buzzard's Bay material with a series from the Atlantic coast from Washington to Florida and from Mobile shows variations in color, marking, roughness of the shell, and in the size and shape of the skull. These variations, however, are not considered sufficient to form a separate race. The evidence that the terrapin is not native to Buzzard's Bay, but was introduced, was considered insufficient.

Dr. Joseph Lincoln Goodale spoke on the vocal sounds of animals and the mechanism of their production. He described the simplest type of larynx; also the four principal types, mentioning the best examples of each type. The three characteristics of sound were noted, and the production and development of voice in man and in mammals described. The vocal cords and the glottis in birds were described, and the control, regulation and volume of voice mentioned.

Mr. C. J. Maynard, in commenting on Dr. Goodale's remarks, described the tympaniform membrane of birds, and mentioned that in the wild goose the whole bronchial tube formed one vibrating membrane. SAMUEL HENSHAW, *Secretary.*

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MARCH 3, 1896.

MESSRS. MORRIS E. LEEDS and J. S. Stokes on behalf of Messrs. Queen & Co. made communications on the historical development of studies in connection with Röntgen photography, presenting the most advanced views regarding the nature of the X-rays as published by various investigators. They also exhibited a series of fine pictures illustrating the application of the process to the study of biology and the results obtained by the use of quick and slow plates and various developers.

Dr. Egbert having alluded to the results obtained by him from the direct rays of the sun through platinum plates, Mr. Leeds called attention to the desirability of experimenting with the sun's rays reflected from a mirror. If a positive result be obtained it would demonstrate either that it is incorrect to say that the rays cannot be reflected, or those producing Dr. Egbert's effects are not Röntgen rays.

Mr. Joseph Willcox presented a collection of 308 recent and fossil Fulgurs from various localities and geological horizons, illustrating with extraordinary completeness the evolution of the form.

A preliminary announcement was made of the presentation, by Dr. A. Donaldson Smith, of fine collections of mammals, birds, reptiles and insects made by him during his recent exploration of western Somali Land, Africa.

EDW. J. NOLAN,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

AT the meeting of February 7th Dr. Marcy in chair and thirty-three persons present, Dr. W. A. Phillips presented a study of flaking refuse, based upon an extensive series of flakes and flaked cobblestones from sites of working, near Benton, Lake county, Illinois. The series offers several hundred outer flakes of which over two hundred are used flakes, assignable to six distinct uses from the character of the wear at edge or surface. Outer flakes are greatly in excess of other flakes in the refuse.

A large number of flaked cobblestones and of unused flakes, smaller, but still from the outside of the stone were treated as waste, nuclei and failures respectively. Specializations of the flake for hafting principally are represented, while further shaping of the cobblestone is wanting in a finished product. It is, however, represented in a limited series of rejects, indicating sporadic use of the nuclei. The rocks here used were diabase, found in the beach gravels of Lake Michigan, near sites. The nature and form of flake was due to the shape of the cobblestone. The operation used in producign the flake and illustrated by experimental results was referred directly to the hammerstone; the stone in the hand yielding the flake, the stone struck resting on the ground and serving only for the necessary percussion. A large number of lantern slides were used in illustration. Microscopic sections of rock from which the flakes came, prepared by Mr. Stebbins under Prof. Crook's direction, were exhibited.

A. R. CROOK,
EVANSTON, ILL. *Secretary.*

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of March 2, 22 persons present, Mr. F. W. Duenckel presented a comparison of the records of the United States Meteorological Observatory, located on the Government building in the city, with the record for the Forest Park station, showing that the daily minimum averaged decidedly lower at the Forest Park station than in the city, while the wind averaged decidedly higher for the city station.

Prof. E. A. Engler spoke on the summation of certain series of numbers.

WILLIAM TRELEASE,
Recording Secretary.

SCIENCE

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SCIENCE

Friday, March 27, 1896.

CONTENTS:

PROPOSED LEGISLATION IN REGARD TO THE METRIC SYSTEM.

We have received from Professor J. K. Rees, Secretary of the American Metrological Society: (1) The Report submitted to the House of Representatives on March 16th, by Mr. Chas W. Stone, from the Committee on Coinage, Weights and Measures. (2) A copy of the bill reported unanimously by the Committee on Coinage, Weights and Measures of the House. (3) A letter addressed by the American Metrological Society to persons interested in the Metric System. (4) A petition form to be signed by any and all persons favoring the bill. The Secretary will be glad to supply copies of the petition to those who will obtain signatures. In order to keep a record of all signers, the Society requests that a duplicate list be sent to the office of the Society at Columbia University, New York.

INTRODUCTION AND CONCLUSION OF THE REPORT SUBMITTED BY MR. STONE.

Almost the only power clearly and expressly vested in Congress by the Constitution which has remained practically unexercised to the present day is that of fixing the standard of weights and measures. This power is conferred in the fifth clause of Section VIII. of Article 1, which enumerates among the powers of Congress " to coin money, regulate the value thereof and of foreign coins, and fix the standard of weights and measures." The same power had also been expressly vested in Congress by the earlier Articles of Confederation, and that part relating to the coinage of money was one of the first exercised, and one in relation to which the power of Congress continues to be most fiercely and passionately invoked to the present day.

In the passage of years the power, carrying with it inferentially the duty, to fix the standard of weights and measures seems to have been largely lost sight of. For more than a generation we lived with no legal standard by which could be determined even the amount of metal which went into the coin that came from our mints. Gallatin procured from France a platinum kilogram and meter in 1821 and from England a troy pound in 1827, and in 1828 the latter was recognized as the standard for mint purposes by the following act:

> For the purpose of securing due conformity in weight of the coins of the United States to the provisions of this title, the brass troy pound weight procured by the Minister of the United States at London in the year eighteen hundred and twenty-seven for the use of the mint and now in custody of the mint at Philadelphia, shall be the standard troy pound of the mint of the United States, conformably to which the coinage thereof shall be regulated.

Meantime both the people and the Government were using such weights and measures as were nearest at hand, derived in the main from the English ancestry, but made by themselves without any authoritative standard for comparison, and as a consequence differing materially from each other. In 1830 the Senate directed the Secretary of the Treasury to have a comparison made of the standards of weight and measure used at the principal custom houses of the United States and report the same to the Senate. This was done, and large discrepancies and errors were found to exist. These discrepancies were nullifying and violating the provision of the Constitution which prescribes that "all duties, imposts and excises shall be uniform throughout the United States." Varying scales and varying measures inevitably produced varying rates of duty. The Treasury Department, therefore, in the exercise of its executive power and as a necessary incident and means to the execution of the law and the observance of the Constitution, adopted for the use of that Department the Troughton scale, then in the possession and use of the Coast Survey, as the unit of length, and the troy pound of the mint as the unit of weight. From the latter the avoirdupois pound was to be derived, assuming that there were 7,000 grains in the pound avoirdupois to 5,760 in the pound troy. For measures of capacity the wine gallon of 231 cubic inches and the Winchester bushel of 2,150.42 cubic inches were adopted. This gave to the Treasury Department the basis of a system of weights and measures to be used in its operations, and in order to promote the general adoption and use of the same throughout the country, Congress, in in June, 1836, adopted the following joint resolution:

> That the Secretary of the Treasury be, and he hereby is, directed to cause a complete set of all the weights and measures adopted as standards, and now either made or in the progress of manufacture for the use of the several custom houses, and for other purposes, to be delivered to the Governor of each State in the Union, or such persons as he may appoint, for the use of the States, respectively, to the end that a uniform standard of weights and measures may be established throughout the Union.

In accordance with this resolution sets of the weights and measures adopted for use in the custom houses were sent to the several States, and only in this indirect and inferential way have the customary weights and measures of the United States been legally recognized. By the Act of March 3, 1881, similar sets of standards were directed to be supplied to the various agricultural colleges which had received land grants from the United States at a cost not exceeding

$200 for each set. This law was complied with as best it could be under the limitation of cost prescribed.

Meantime the metric system had come into extensive use among other nations, and into almost universal use in the realm of exact science the world over. We touched it at every turn in our commercial relations and scientific investigations. Uniformity in weights and measures throughout the the world was urged not only by scientists, but by sagacious business men, seeking to keep pace with the rapidly-growing tendencies to closer commercial and business relations among the nations resulting from the improved facilities of communication and transportation which had largely removed the barriers of space and distance. Hence in 1866 Congress, with the approval of the President, placed on the statute books the following law:

AN ACT to authorize the use of the metric system of weights and measures.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this Act it shall be lawful throughout the United States of America to employ the weights and measures of the metric system, and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.

SEC. 2. *And be it further enacted*, That the tables in the schedule hereto annexed shall be recognized in the construction of contracts, and in all leading proceedings, as establishing, in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the metric system; and said tables may be lawfully used for computing, determining and expressing, in customary weights and measures, the weights and measures of the metric system.

To make this law of practical use the following joint resolution was adopted:

JOINT RESOLUTION to enable the Secretary of the Treasury to furnish each State with one set of the standard weights and measures of the metric system.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he is hereby authorized and directed to furnish to each State, to be delivered to the Governor thereof, one set of standard weights and measures of the metric system for the use of the States respectively.

By inadvertence and without important legal significance the resolutions providing for furnishing the standards became a law before the act authorizing the use of the system. In the same year Congress put it in the power of the Post-Office Department to make extensive use of metric weights in its operations. The law of that year was restated and reënacted in 1872 and now stands in the Revised Statutes in the following terms:

The Postmaster-General shall furnish to the post-offices exchanging mails with foreign countries, and to such other offices as he may deem expedient, postal balances denominated in grams of the metric system, fifteen grams of which shall be the equivalent for postal purposes, of one-half ounce avoirdupois, and so on in progression.

The International Postal Convention of two years later, and which by subsequent renewals is now in force between the United States and fifty other nations, uses only metric weights and terms, and to-day the mail matter transported between this country and other nations, even between the United States and England, is weighed and paid for entirely in terms of metric weights.

Here legislation on the subject of weights and measures rests till 1893. In the meantime important action was taken by the Executive Department of the Government. The progress of science, carrying with it the capability of more accurate observation and measurement, had disclosed the fact that the metric standards in use in different countries differed among themselves, and indicated that even the standards in the archives of France could be constructed with greater precision and accuracy and preserved with greater safeguards against possible variation from influence of the elements or other forces. Hence France invited the other nations to join in an international commission for the purpose of constructing a new meter as an international standard of length. This country accepted the invitation and was represented in the commission, which met in 1870 and continued its labors from time to time till they were finally consummated in the conclusion of a metric convention signed on May 20, 1875, by the representatives of the following nations, viz.: The United States, Germany, Austria-Hungary, Belgium, Brazil, Argentine Confederation, Denmark, Spain, France, Italy, Peru, Portugal, Russia, Sweden and Norway, Switzerland, Turkey, and Venezuela.

The first name signed to this convention is that of E. B. Washburn, the United States Minister and Representative. The treaty provided for the establishment and maintenance, at the common expense of the contracting nations, of "a scientific and permanent international bureau of weights and measures, the location of which shall be Paris," to be conducted by "a general conference for weights and measures, to be composed of the delegates of all the contracting governments." Beyond the construction and custody of the international standards and the distribution to the several countries of copies thereof, it was expressly provided as to this conference by the terms of the treaty or convention that "it shall be its duty to discuss and initiate measures necessary for the dissemination and improvement of the metrical system." This convention was duly ratified by the Senate, and since that time the United States has been regularly represented in the International Conference and has paid its proper proportion of the cost of maintaining the International Bureau of Weights and Measures. By the terms of the convention the privilege of acceding thereto and thus becoming a party to it was reserved to any nations desiring to avail themselves thereof, and accordingly the following nations have since become parties to the convention, viz., Servia in 1879, Roumania in 1882, Great Britain in 1884, Japan in 1885 and Mexico in 1891.

New standards were prepared with extreme care and accuracy, and duplicate copies thereof distributed to the several nations. Those for the United States were received with much ceremony at the White House, January 2, 1890, by the President in the presence of members of his Cabinet and other distinguished gentlemen, and are now carefully guarded in a fire-proof room set apart for the safe-keeping of the standards of weights and measures in the Coast Survey building.

By formal order of the Secretary of the Treasury of April 5, 1893, the meter and kilogram thus received and kept were recognized as 'fundamental standards' from which the customary units of the yard and pound should be thereafter derived in accordance with the law of July 28, 1866.

Meantime Congress by act of March 3, 1893, established a standard scale for measurement of sheet and plate iron and steel, expressed in terms of both the customary and metric measures. 'An act to define and establish the units of electrical measure' was passed by the Fifty-third Congress and approved July 12, 1894. It is based on the metrical system exclusively.

From this résumé of our legislation on the subject of weights and measures it appears that a legal standard of weight has been established for use in the mint, but that beyond that our weights and measures in ordinary use rest on custom only with indirect legislative recognition; that the metric weights and measures are made legal by direct legislative permission, and that standards of both systems have been equally furnished by the Government to the several States; that the customary system has been adopted by the Treasury Department for use in the custom houses, but that the same Departmnet by formal order has adopted the metric standards as the 'fundamental standards' from which the measures of the customary system shall be derived. This presents a condition of legal complication and practical confusion that ought not to continue. The constitutional power vested in Congress should be exercised. Before considering how this should be done, it may be instructive to consider the attempts that have heretofore been unsuccessfully made in that direction.

* * * *

Your committee are not blind to the fact that considerable temporary inconvenience will accompany the change, but they believe that this is greatly overestimated and that it will be of short duration. This belief is founded on the experience of other nations less agile and versatile of intellect than we are, but whether the inconvenience be little or great it must some time be encountered, and it will not be decreased by the increase of our population. It will be no easier for a hundred millions of people ten years hence to make the change than for seventy millions to-day. It is simply a question whether this generation shall accept the annoyance and inconvenience of the change largely for the benefit of the next, or shall we selfishly consult only our own ease and impose on our children the double burden of learning and then discarding the present 'brain-wasting system.' The present generation must meet this test of selfishness or unselfishness, and answer to posterity for duty performed or neglected. The neglect of our fathers cannot justify us. They delayed for a greater light and clearer way. Passing years have brought the light, and the action of other nations has cleared the way.

A nation ordinarily progressive can not longer afford to linger in the rear of this great movement. A position of isolation is not consistent with American capacity or American destiny. Her sister American republics have appealed to this country to unite with them in this great reform. Her great Secretary of State joined in this appeal. Successive Secretaries of the Treasury, including the present head of that Department, have formally recommended it. Other eminent citizens, many representatives of a great commercial interest, the prevailing sentiment among her educators, the practically unanimous voice of her scientific men, ask for this legislation. By formal memorial the Governor and Legislature of a sovereign State join in this appeal. The experience of other nations confirms the belief in its wisdom. The commercial interests of our people, the economy of time, the saving of effort, even national honor, demand action on this subject.

The signature of our duly accredited representative leads the signatures to the compact of 1875, creating an agency "to discuss and initiate measures necessary for the dissemination and improvement of the metrical system," and since then she has been one of the largest contributors and most prominent actors in the work of guarding and testing the international metric standards and of constructing and distributing prototype copies of the same to other nations. On what theory are we thus zealously engaged in the 'dissemination' of the metric system except that its universal use is desirable; and if desirable for the other nations, why not for the United States? "With what measure ye mete, it shall be measured to you again."

In 1888 (by resolution of May 24) this country invited the republics of Central and South America, Mexico, Haiti and San Domingo, to a conference to be held in the city of Washington to consider among other things 'the adoption of a uniform system of weights and measures.' The invitation was accepted; the conference was held. To the extent of its power it adopted a uniform system of weights and measures. The other nations, parties to the conference, with scarcely an exception have honorably proceeded to put in force in their respective limits the metric system thus adopted. On what principle of international honor can the United States, the originator of the conference, stand alone in refusing or delaying to abide by its action? What possible motive can this country have in thus coquetting longer on this subject with the nations of Europe and her sister republics? Having sought the verdict of a tribinal of our own choosing shall we fail to stand by its decision? A nice sense of honor, no less than her own interests, would seem to demand from the United States definite and complete action which should put her in full accord on this subject with the nations with which she has so long ostensibly been coöperating.

Your committee in the investigation of this subject have not only heard such gentlemen as saw fit to come before them, but they sought the views of officers of the Government whose work would be most directly affected by the proposed change. They have examined the facts submitted to former committees of this House, and have availed themselves of the testimony lately taken before the committee of the House of Commons of England in their investigation of this subject extending over several months. They have sought to learn by letters of inquiry to the Superintendent of Public Instruction of each of the States, as well as the Commissioner of Education of the United States, the extent to which instruction is now afforded in the metric system in the various States. The replies indicate that this instruction varies much as the educational progress of the States varies. Utah has placed in her constitution a provision requiring such instruction in all the public schools. In all the States the instruction is largely abstract and theoretical, and necessarily so, but the moment the system goes into practical operation, or it becomes certain that it is to go into operation at no very distant date, the character of the instruction will at once change and become practical. The English school authorities are already furnishing to schools asking for them actual specimens of the liter, meter, etc., and a similar course by the school authorities of this country would be wise.

Your committee, after a careful consideration of this subject, have unanimously reached the conclusion that the metric system of weights and measures should be put into exclusive use in the various Departments of the Government at such future date as shall allow adequate preparation for the change, and at the end of a fixed time thereafter that said system shall be recognized as the only legal system for general use. They, however, do not deem it wise at present to require a change in the methods of surveying the public lands, as this would in that respect destroy rather than promote uniformity.

Your committee also deem it prudent to enlarge the time for the proposed system to take effect to a date somewhat later than the date proposed in the bill submitted, adopting for this country about the average time deemed necessary by other nations. Your committee, therefore, recommend that the time for adoption in the Departments and operations of the Government, except in the completion of the survey of the public lands, be fixed for July 1, 1898, and that the adoption of the metric system for use in the Nation at large be fixed as coincident with the dawn of the twentieth century, and that date be accordingly changed to January 1, 1901, the first day of the new century.

Your committee also deem some changes

in phraseology desirable in the proposed law to avoid ambiguity and uncertainty. To most clearly and intelligently express those proposed changes and the scope of the bill after they are made, your committee have embodied them in a substitute bill which they report herewith and respectfully recommend that it do pass.

A BILL to fix the standard of weights and measures by the adoption of the metric system of weights and measures.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the first day of July, eighteen hundred and ninety-eight, all the Departments of the Government of the United States, in transaction of all business requiring the use of weight and measurement, except in completing the survey of the public lands, shall employ and use only the weights and measures of the metric system.

SEC. 2. That from and after the first day of January, nineteen hundred and one, the metric system of weights and measures shall be the only legal system of weights and measures recognized in the United States.

SEC. 3. That the metric system of weights and measures herein referred to is that in which the ultimate standard of mass or weight is the international kilogram of the International Bureau of Weights and Measures, established in accordance with the convention of May twentieth, eighteen hundred and seventy-five, and the ultimate standard of length is the international meter of the same bureau, the national prototypes of which are kilogram numbered twenty and meter numbered twenty-seven, preserved in the archives of the office of standard weights and measures.

SEC. 4. That the tables in the schedules annexed to the bill authorizing the use of the metric system of weights and measures passed July twenty-eighth, eighteen hundred and sixty-six, shall be the tables of equivalents which may be lawfully used for computing, determining and expressing the customary weights and measures in the weights and measures of the metric system.

LETTER SENT ON MARCH 15, 1896, FROM THE OFFICE OF SECRETARY, AMERICAN METROLOGICAL SOCIETY, COLUMBIA UNIVERSITY, NEW YORK.

DEAR SIR: You are aware, no doubt, that the Committee on Coinage, Weights and Measures, of the House of Representatives, Hon. C. W. Stone, Chairman, has directed that a favorable report be made, to the House, of a bill making the use of the metric system obligatory in the United States after certain dates named in the bill. The bill reported is a substitute for the Hon. D. M. Hurley's bill. A copy of the substitute bill is enclosed.

It is very important that all interested in this bill should act promptly and vigorously.

If you are in favor of the bill sign the enclosed petition and obtain on it the signatures of friends in your neighborhood. Mail the signed petition, with a personal letter, as soon as practicable, to your Representatives in Washington, D. C. Kindly send the Society a postal card stating when you sent the petition and the number of names signed.

The Society would be glad to know the condition of feeling toward the metric system in your vicinity.

Yours respectfully,

B. A. GOULD,
President.
J. K. REES,
Secretary.

FORM OF PETITION.

The undersigned citizens residing in his Congressional District respectfully urge the Honorable Mr. ———— to consider favorably and vote for the bill reported to the House of Representatives by the Committee on Coinage, Weights and Measures, to fix the standard of weight and measures by the adoption of the metric system of weights and measures.

ON THE REFLECTION OF THE RÖNTGEN RAYS FROM PLATINUM.

THE interest connected with this subject led me on March the 9th to undertake a set of experiments, and indications were almost immediately obtained that a small percentage of the so-called X-rays were reflected by a platinum surface placed at an angle of forty-five degrees. The exposure of the sensitive plate, however, was not sufficiently prolonged; neither was it properly shielded from the anode end of the discharge tube. Matters were finally arranged so that the plate-holder was completely shielded from all parts the discharge tube by screens of heavy sheet lead, and on March 13th, after an exposure of ten hours, a satisfactory negative was obtained, capable of furnishing prints.

The apparatus employed was of the simplest character; a coil of moderate size, made by Ruhmkorff more than thirty years ago, was excited by a current suitable for class-room experiments, no condenser whatever being employed. The Crookes' tube was of German make, and had originally been intended only for class demonstrations. With aid of a fluorescent screen it had been carefully studied, and the best portion of it was employed. The reflecting surface consisted of a new sheet of ordinary platinum foil, which was held rather loosely against a plate of glass, no attempt being made to remove its accidental deformations, which were mainly paralleled to the axis of the cylinder, which it had formed when rolled on its stick. These elongated deformations, convex and concave, were placed vertically.

The plate holder, in addition to its draw slide, was completely covered by a plate of aluminium with a thickness of 0.17 mm.; the central horizontal portion of this was again covered by a broad strip of the same aluminium plate, and over the whole was fastened a netting of iron wire, destined to furnish the image. I may remark in passing that I have found wire netting very useful in other experiments with the X-rays, as it gives instant information as to the condition of the field with regard to uniformity of illumination, single or double sources of the rays, and also with regard to the relative transparency of objects placed on the plate holder.

The plate holder being arranged as indicated, care was taken that rectilinear emanations from the discharge tube should not even reach the external wooden portions of its frame.

After an exposure of ten hours it was found that a good image of the netting had been produced on the vertical strip of the plate exposed to the reflected rays. This image had various deformations, the vertical lines representing the netting being as a general thing most distinct; in some places, however, the horizontal lines had the upper hand, and there were a few spots where both were equally distinct. The image under those portions protected by two thicknesses of aluminium plate was perhaps a trifle fainter than that on the rest of the plate. These facts and the character of the deformations point very strongly to the conclusion that in the act of reflection from a metallic surface the Röntgen rays behave like ordinary light.

Photographic experiments were then made to ascertain the percentage of the rays reflected. A plate from the same box was placed at a corresponding distance (6.5 inches) from the discharge tube, and the exposure diminished, till a similar image was obtained. It was, of course, protected in the same way as in the experiment on reflection, and developed for the same length of time. This image was not in any way deformed. After an examination of it by Mr. F. J. Harrison, Professor Hallock and myself, the conclusion was reached that the reflected image had the same intensity. This would indicate that platinum foil reflects the $\frac{1}{260}$ part of the X-rays incident on it at an angle of 45°. Of course this figure is to be regarded as a first approximation.

In conclusion, I may add that the greatest care was taken to obtain the most sensitive plates and the most powerful developer known, and that this matter gave much more trouble than the experiment just described. OGDEN N. ROOD.

COLUMBIA UNIVERSITY, NEW YORK.

FURTHER EXPERIMENTS WITH X-RAYS.

PHOTOGRAPHS have now been obtained with several of the Crookes tubes in the cabinet of the Dartmouth Laboratory, but the one referred to in a previous communication is by far the most efficient, and it has been used in nearly all the experiments now to be described. This tube was made by Stoehrer, of Leipzig, being No. 1147 of his catalogue, where it is designated as Puluj's neue Phosphorescenz-Lampe. It contains a mica diaphragm coated with some phosphorescent substance, and gives quite a brilliant green light when in action (although this brilliancy is doubtless immaterial to the production of the X-rays).

As to the source of the X-rays developed by this tube it may be stated that a variety of experiments have shown that they originate in the diaphragm itself where exposed to the cathode rays, and not to any appreciable degree in the glass around the diaphragm. Cathode rays which pass through the diaphragm appear, however, to develop X-rays at the surface of the glass where they impinge.

The method first adopted for determining the position of the source was that of calculating its distance from the plate from the magnification of the shadows of intervening opaque objects, but this procedure brought out anomalies, as will presently be mentioned. By bringing the plate near the tube, the diaphragm could be made to cast its own shadow, and the resulting appearance leaves no doubt that the X-rays chiefly originate in a limited portion of the diaphragm. The method of using a series of parallel films leads to the same conclusion, and indicates that in this tube the rays do not proceed directly from the cathode itself.

Lenard has observed that the cathode rays are diffracted around the edges of obstacles. In case of the X-rays our experiments indicate an effect apparently somewhat the reverse of this. While the shadow of an obstacle is always magnified, and often to a degree disproportionate to the distances involved, we have obtained several plates showing the impression from an aperture in an opaque object to be slightly minified, when the plate is sufficiently near the object. This would point to an outward rather than an inward bending of the rays. In this connection attention is called to a curious phenomenon presenting to the eye the appearance of irradiation, although it is difficult to believe that any real analogy to irradiation is offered.

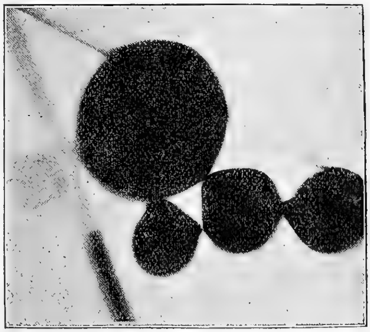

FIG. 1. DISTORTION OF COINS PHOTOGRAPHED WITH X-RAYS.

The coins shown in Fig. 1, are a silver dollar, a dime, and two nickels, in contact, all perfectly round; a glass rod (ending in a brass cap) touches the dollar, and a small piece of hard rubber prevents it from rolling. The line across the plate, through the shadow of the dollar, is the image of the mica diaphragm, the plane of which was nearly perpendicular to the plate. The tube was but 14 mm. above the coins and 17 mm. above the film. The magnification of the shadows is slight, but the distortion is almost grotesque. Plates showing this effect can be easily obtained.

It should be stated that the nearness of any conductors, as these coins, to the tube in action will produce in them a considerable static charge, as may be readily tested by a proofplane and electroscope. This may possibly have a bearing upon the cause of the distortion.

The rectilinear path of the X-rays after they have passed by an obstacle has been proved by the use of a long strip of celluloid film, as used in Kodak cameras. A framework like two parallel ladders was so made that the film could be tightly drawn across the rounds with successive portions parallel and at a distance of 10 mm. from each other, the whole being enclosed in a light-tight box. The X-rays so readily penetrated the gelatine and celluloid that their effect could be seen through more than twenty of these equidistant layers. A circular piece of silver was attached to the celluloid side of the front film, and the diameter of its shadow could after development be quite accurately measured on eight successive layers, although growing diffuse as the distance increased. The ratio of the successive diameters was constant, as would be the case with a rectilinear path. Of course the axis of the 'shadow cone,' given by the position of the circles of the shadow, passes through the source of the rays. On some of the films exposed in this way very curious markings are seen which we are as yet unable to explain.

This use of films at once suggests the need of a new kind of sensitive plate for photographing with X-rays which shall absorb them far better than does the ordinary dry plate. When a strip of film was folded up on itself, so that there was no loss of intensity by increase of distance from source, the impression was hardly less strong on the twelfth than on the first layer; and an impression could doubtless be transmitted through a hundred layers. It follows that the time of exposure necessary for X-ray photographs could be diminished in proportion as the plates are made to absorb the energy falling upon them. On account of the opacity of platinum, it occurred to me to try platinum photographic paper of the kind used for portraits, but such paper (intended for long exposures in printing in sunlight) was far too lacking in sensitiveness to produce any effect. It ought to be easily possible for our photographic chemists to produce plates which should require but one-twentieth or less of the exposure now required for X-rays with ordinary plates.

The writer has succeeded in repeating Röntgen's reflection experiment, except that a celluloid film was used instead of the less permeable glass plate. Nickel and copper disks were attached to the under side of the film, and after exposure (70 minutes) their effect in reflection was shown by the greater intensity of the dark (or negative) circles above them.

Certain plates gave anomalous results of reflection, the portion of film above the reflecting object being affected less intensely than the rest of the film; that is, the outline of the object *beneath* the film is shown, but is lighter on the negative than the surrounding area, instead of darker, as would be expected.

On four of our plates an appearance strikingly like interference fringes can be observed, and thus far we can only account for it on the supposition of reflection from the brass spring which presses against the glass side of the plate in the holder, thus keeping the plate in place. Numerous attempts have been made to obtain interference fringes after the analogy of Newton's rings, but thus far unsuccessfully.

The difficulty found by Professor Emerson and myself in *precisely repeating* most of these experiments has doubtless been experienced by others working with the X-rays. When the conditions of an exposure seem identical with those of a previous one, the results often differ, from varying excitation of the tube, or possibly slight shifting of the source of the rays, or from numerous other causes difficult to control. A confirmation of results by other observers is therefore valuable.*

Since the last paragraph was in type I have succeeded in proving that the 'fringe' is due to the spring by the somewhat surreptitious method of placing a second Crookes tube behind the plate, and thus projecting a shadow of the spring itself upon the plate on which at the same time the spring was reflecting the fringe. Fig. 2, is from a plate obtained a fortnight ago. A silver dollar lay on the slide above the plate, directly over the spring which was behind the plate; the tube was 14 mm. above the plate and the exposure was one hour. The X-rays must have passed through the silver dollar and then have been reflected by the spring, giving the 'fringe.' Since the central bright line is much brighter than the other portions of the plate partially screened by the dollar, it would seem that this additional brightness can only result from the superposition of waves in the same phase, or, in other words, from something closely akin to interference. Similar fringes have been obtained through tinfoil instead of silver, and also where no obstacle intervened between tube and film. We hope by this method to obtian the wave-length of the X-rays.

EDWIN B. FROST.

HANOVER, N. H., March 10, 1896.

FIG. 2. SHOWING REFLECTION AND INTERFERENCE OF X-RAYS.

*In a previous communication (p. 235), a slip of the pen made me invert the order of permeability of hard rubber, glass and brass; the rubber is of course the most permeable.

THE RECEPTION OF FOREIGN STUDENTS IN FRENCH UNIVERSITIES AND SCHOOLS.

IN order to carry out effectively the plan for the reception of foreign students in the schools of France, in which there is now so much interest, the French government has formed a Committee of Patronage for the purpose of receiving new comers, giving them encouragement, and furnishing them with all necessary information in regards to their studies and facilities for life in the university towns. The object of these Committees is to make the student's stay in France agreeable as well as profitable. They also offer their friendly offices to the families of students.

THE PARIS COMMITTEE.

The Paris Committee has its headquarters at the Sorbonne, and is composed of the following members:

MM. Emile Boutmy, Member of the Institute; Director of the *École libre des sciences politiques* Michel Bréal, Member of the Institute. Xavier

Charmes, Member of the Institute. Darboux, Dean of the Faculty of Science. Gréard, Member of the French Academy; Rector of the *Academie de Paris.* Himly, Dean of the Faculty of Letters. Lamy, formerly Deputy. Lavisse, Member of the French Academy. Liard, Director of Higher Education. Paul Melon, General Secretary. Georges Picot, Member of the Institute. Albert Sorel, Member of the Institute. Vicomte Melchior de Vôgue, Member of the French Academy.

A secretary is stationed in the office of the Committee, who will be for two hours each day at the service of persons desiring to obtain detailed information concerning life in Paris or the character of the instruction given in the different educational establishments.

There is an executive committee charged with the duty of maintaining regular connections with the different groups of foreign students in Paris.

The Paris Committee expects to be able to give scholarships of 200 to 350 francs to students especially recommended; these scholarships to be exclusively employed in payment of University fees.

THE COMMITTEE OF AIX.

This Committee, under the patronage of the Rector of the *Académie*, the Mayor of Aix, the Dean of the Faculty of Law and the Dean of the Faculty of Letters, is composed of Prof. Bouvier-Bangillon, of the Faculty of Law; M. Moreau, Adjunct Professor in the same Faculty; Prof. Ducros, of the Faculty of Letters, and M. Carbonel, Secretary of the Faculty of Law.

The Committee has arranged with transportation companies for reduction of fares for the benefit of students, and will neglect nothing which has to do with their moral and material interests.

Special courses of instruction in the French language, for the benefit of foreigners, have for many years been organized in connection with the Faculties of Aix.

THE BORDEAUX COMMITTEE.

This Committee is composed of Prof. Bouchard, of the Faculty of Medicine; Prof. Gayen, of the Faculty of Sciences; Prof. Denis, of the Faculty of Letters, and Prof. Duguit, of the Faculty of Law, acting as Secretary.

THE LYONS COMMITTEE.

This Committee is composed of professors from the four Faculties: Prof. Lepine, of the Faculty of Medicine; Prof. Offret, of the Faculty of Sciences; Prof. Bourgeois, of the Faculty of Letters, and Prof. Berthelemy, of the Faculty of Law. There is, besides, a special committee composed of friends of the University, presided over by M. Cambfort, which will give special attention to questions connected with the interests of foreign students. The Secretary of this Committee is M. Thallers, of the Faculty of Law.

THE MONTPELLIER COMMITTEE.

This Committee has as its Secretary Prof. Flahaut, of the Faculty of Sciences, and, among other members, Prof. Bonnett, of the Faculty of Letters; Prof. Gidde, of the Faculty of Law; Prof. Gachon, of the Chair of History in the Faculty of Letters; M. Tempie and others. It has established certain courses free to foreigners, an elementary course and an advanced one. It will provide students with information concerning living facilities suited to their means, and will see that they are furnished with medical attendance.

THE NANCY COMMITTEE.

This Committee is composed of the four deans of the faculties of the University: MM. Bichat, Heydedireigh, Krantz, Lederlenen, M. Schlagdenhauffen, director of the School of Pharmacy; M. Gavet, associate professor of the Faculty of Law; Prof. Molk, of the Faculty of Sciences; Prof. Bernheim, of the Faculty of Medicine; Prof. Grucker, of the Faculty of Letters, and Prof. Bleicher, of the *École supérieure de pharmacie.*

M. Bichat, Dean of the Faculty of Sciences, and M. Gavet, will devote themselves especially to the interests of foreign students at Nancy.

The Committee has formed in connection with the Students' Association, a special section for colonial and foreign students, the Vice-Presidents of which will be elected by the foreign students.

THE TOULOUSE COMMITTEE.

The President of this Committee is Dr. Maurel, and among its members are public officials of Toulouse, the deans of faculties, the directors of the schools of veterinary science, fine arts and music, and a certain number of persons who are considered by the consular officers resident at Toulouse especially likely to command the confidence of the families of foreign students.

The Committee will correspond with organization abroad or with families who contemplate sending to Toulouse students for a sojourn of some length. It will do all in its power to secure for foreign students engaged in regular courses of study the pecuniary opportunities which are enjoyed by French students. It has arranged with the Students' Association to extend to foreigners all the advantages which belong to its own members, and their admission to such official or private receptions as may occur.

The Committee offers to foreign students the following advantages: The opportunity to draw money in Toulouse without commission or discount; gratuitous medical service; hospital accommodations at half price; free admission to the meetings of the Geographical Society; free admission to the reading room; reduction of rates at hotels selected during the first eight days after arrival, and reception at the railway station, if desired.

THE FRANCO-AMERICAN SYNDICATE.

In connection with this movement there has also been organized by a number of learned and representative men of France, a body called the 'Franco-American Syndicate,' the object of which is 'to promote and develop intellectual, social and moral relations between France and the United States.'

The intention of this Syndicate is to bring American students into direct relations with representative men of France, especially those who are representatives in their several professions.

The gentlemen who have volunteered to assist, not being directly engaged in official duties, have time at their disposal to devote to this work. The Honorary Chairman of the Syndicate is the Comte Carré de Busserolles, Brigadier General, retired, and Commander of the Legion of Honor; its President is Comte Henri du Bourg, and its Vice-President, Mons. P. de Rousiers, the author of a well-known work upon American life; and among its members are the Comte Perouse de Monclos and Mons. G. Balleyguier, architects; Mons. S. Thore, engineer; Mons. O. Coignard, Forestry Inspector; Dr. Chaillou, of the Pasteur Institute, and Mr. J. C. Van Eyck, of New York city, Member of the Royal Institute of the Netherlands. A number of eminent men, several of them members of the Institute of France, who on account of their official positions are unable to take active part in the work of the Syndicate, have promised their support and coöperation, as have also several army and navy officers of high rank.

It is the hope of this organization to have a house in Paris where there may be frequent gatherings of American students for social intercourse with these gentlemen and to listen to lectures, and that here also may be arranged plans for the advantageous utilization of the university holidays for purposes of professional study under the direction of competent Frenchmen.

The representative of the Syndicate in

Paris is Mons. G. Balleyguier, architect, 238, Boulevard St. Germain; and the representative of the organization in the United States is Dr. J. C. Van Eyck, Century Club, New York.

GENERAL INFORMATION FOR STUDENTS.

The following information is given concerning the admission of foreign students into the faculties and schools of France:

Instruction is absolutely gratuitous in the universities and faculties of France. They are open without reserve to strangers as well as to native students, and the grades established are the same for each. It is required, however, that both foreign and native students should give evidence of certain preliminary study. In the case of the French student this consists in the presentation of a bachelor's diploma certifying that courses of secondary instruction of a given nature have been completed. Strangers who have obtained from institutions in their own country certificates of instruction are admitted after a ruling shall have been made by the Minister based upon the advice of the proper section of the Advisory Committee on Public Instruction, whose duty it is to ascertain the actual value of the certificate offered. This is rendered necessary by the fact that the certificates of study in France and in foreign countries are not always equivalent in value.*

The requirements in connection with obtaining degrees in the courses of higher instructions are the following: Matriculation, access to the library, privileges of practical work (only in the faculties of medicine and the schools of pharmacy), examination, certificate of proficiency, and diploma. The fees for matriculation are 30 francs quarterly, or 120 francs per year. Library privileges cost 10 francs per year. The fees for examination and diploma vary from 40 to 100 francs per year, according to the faculties.

These provisions relate only to students who are candidates for degrees. Those who wish simply to receive the instruction given by a faculty, without asking a certificate or diploma, will be permitted the greatest freedom of action.

Foreigners who give evidence of sufficient previous instruction will be admitted into most of the special schools either as pupils or as free auditors.

In a subsequent article, information will be given in regard to the facilities offered by the principal universities and special schools.

G. BROWN GOODE,

Secretary of the American Branch of the Comité Franco-Americain.

* Graduates of foreign universities who desire to enter the courses of the faculties should address an application to the Minister of Public Instruction, accompanied by (1) the original diplomas, with a request that their equivalence in France be determined, and that they be approved; (2) a certificate of birth (original and translation).

THE ESSENCE OF NUMBER.

NUMBER is primarily a quality of an artificial individual. By artificial is meant 'of human make.' The characteristic of these artificial individuals is that each, though made an individual, is conceived as consisting of other individuals. In language the designations for artificial individuals so characterized usually contain other connotation. Examples are a flock, a herd, a bevy, a covey, a throw, a flight, a swarm, a school, a pack, a bunch, a cluster, a drove, a company, a brood, a group, etc. To any such artificial individual pertains an important quality, its 'Anzahl,' which may agree or differ among such artificial individuals, as may their color. But something like color is made and recognized by insects and animals, so that color is not so highly artificial as number, but will serve for an illustration. Just as the color of a bunch of grapes might be identified by use of a card of standard colors, and so a particular descriptive color name attached to the bunch, in the same way by a well-known process of identification its 'Anzahl' may be determined and the proper descriptive name attached. This particular process of identification is called counting, and used originally the standard set of artificial individuals makable from the fingers.

The creation of artificial individuals having this numeric quality, 'Anzahl', the creation of number of necessity preceded counting, which is only a subsequent process for identification, for finding the 'Anzahl' where it is already known to be.

Number is so peculiarly human a creation that it might be used as an argument for the unity of mankind. Man has found it advantageous to perceive in nature distinct things, the primitive individuals. Each distinct thing is a whole by itself, a unit. The primitive individual thing is the only whole or distinct object in nature. But the human mind takes primitive individuals together and makes of them a single whole, an artificial individual and names it. These are artificial units, discrete magnitudes. The unity is wholly in the concept, not in nature. It is of human make.

From the contemplation of the primitive individual in relation to the artificial individual spring the related ideas 'one' and 'many.' A unit thought of in contrast to 'many' as not-many gives us the idea *one* or 'a one.' A 'many' composed of 'a one' and another 'one' is characterized as 'two'. A many composed of 'a one' and the special many 'a two' is characterized as 'three.' And so on, at first absolutely without counting, in fact before the invention of that patent process of identification now called counting. The 'Anzahl' of a group is wholly abstract, in that it represents all at once the primitive individuals or elements of the group or artificial individual, and nothing more. There never was and never will be a concrete number or anything concrete about number.

The number in the sense of 'Anzahl' of a group is a selective photograph of the group, a numeric picture which takes or represents only one quality of the group, but takes that all at once. This picture process only applies primarily to those particular artificial wholes which may be called discrete aggregates. But these are of inestimable importance for human life.

This overwhelming importance of the number-picture after centuries led to a human invention as clearly a device of man for himself as is the telephone. This was a device for making a primitive individual thinkable as a recognizable and recoverable artificial individual of the kind having the numeric quality. This is the recondite device called measurement.

Measurement is an artifice for making a primitive individual conceivable as an artificial individual of the group kind, and so having an 'Anzahl,' a number picture.

It may be likened to dyeing cotton with analine dyes. This will give the cotton a color which may then be identified by comparison with the set of standard colors.

The height of a horse, by use of the artificial unit, a 'hand,' is thinkable as a discrete aggregate and so has a number-picture identifiable by comparison with the standard set of pictures, that is by counting, as say 16. But to argue from this the implicit presence of the measurement idea in every number is the analogue of maintaining the implicit presence of the process-of-dyeing idea in every color.

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

ROBERT EDWARD EARLL.

MR. ROBERT EDWARD EARLL, who died on March 18th, at 'Chevy Chase,' near Washington, was one of the oldest and most trusted members of the staff of the Smithsonian Institution, with which he had been connected in various capacities since 1877. He was born at Waukegan, Illinois, August 24, 1853, educated in the Waukegan public schools, the University of Chicago, and at the Northwestern University, where he was graduated in 1877 with the degree of B. S. He entered the service of the Fish Commission, under Prof. Baird, as a fish culturist; in 1878 was transferred to the scientific staff, and from 1879 to 1882 was engaged in the Fisheries Division of the Tenth Census.

From 1885 to 1888 he was Chief of the Division of Statistics in the Fish Commission. He was sent, in 1883, to the International Fisheries Exhibition in London, as a member of the staff of the United States Commissioner, and rendered very efficient service as executive officer and deputy representative. His aptitude for exposition work was so fully demonstrated on this occasion that he has been designated chief executive officer, at all the expositions which have since been held, for the exhibits of the Smithsonian Institution and the National Museum; at Louisville and New Orleans in 1884 and 1895, Cincinnati in 1888, Chicago 1893 and Atlanta in 1895. At the time of his death he had just completed the unpacking of the exhibits returned from the South.

Since 1888 he had been connected with the National Museum, with the grade of Curator, and for three years had been Editor of the Proceedings and Bulletins of the Museum.

He was recognized by his associates as man of fine administrative ability, which, combined with great force of character, had brought him into the position of one of the most efficient exposition experts living. His unselfish devotion to his work, and his absolute trustworthiness were appreciated by all who knew him, and he was exceedingly popular among his associates.

Notwithstanding his constant occupation in executive work, he produced and published a considerable number of important papers in regard to the methods of the Fisheries and the habits of fishes. He was one of the best authorities upon the natural history of the Shad and Herring, and made exhaustive studies of the fishery statistics of the Atlantic and Gulf coasts and of the Great Lakes. Several new fishes were discovered by him, one of which, an important food species of the Southern coast, obtained by him at Charleston in 1881, is called in his honor Earll's Hake, *Phycis Earlii.* He was also a skilful fish culturist and had much experience in the early experimental work in the propagation of the Shad and in the establishment of the Cod-hatching station at Gloucester.

He was a man of the purest personal character. His loss will be deeply felt by many in Washington. By reason of his peculiar abilities and his great experience, his death creates a void which it will be practically impossible to fill.

G. BROWN GOODE.

CURRENT NOTES ON PHYSIOGRAPHY.

THE STUDY OF HOME GEOGRAPHY IN ITALY.

AT the Second Italian Geographical Congress, held in Rome last September, the president, Marquis Doria, included in his opening address an earnest recommendation for the cultivation of home geography. Recognizing the glory of foreign exploration, he nevertheless said that the patient study of the fatherland is a scientific duty, and that the culture of a nation may be measured by its advance. The Congress adopted votes urging the establishment of better courses in geography in various stages of education; and advising the Italian Geographical Society to offer a prize for the best plan of primary instruction in local geography, and afterwards to secure the best geographical writers of Italy to prepare text-books according to the approved plan for local use. The latter suggestion is one that may be commended to the councils of our American and National Geographical Societies.

THE DANUBE.

A COMPENDIOUS volume on the Danube, by Schweiger-Lerchenfeld (Die Donau als Völkerweg, Schiffahrtstrasse und Reiseroute, Vienna, Hartleben, 1896, 950 p, with many and excellent illustrations and maps) contains much material for the physiographer; truly not the result of original investigation now first published, but well summarized from many sources and acceptable for those who have to study this great international river at a distance. Most serviceable is the description of the various features of the great Hungarian plain, the Alföld, as it is locally called, through which the Danube and its chief tributary, the Theiss, wind their courses. Sand dunes make deserts of large areas; other parts are wet and marshy beyond redemption, and a third division includes the Puszta, or fertile grassy plains. Many districts have been subject to overflow; but these are now reduced by the 'regulation' of the larger rivers, as well as by the construction of dikes. Below the 'Iron gate' in the Carpathians, the course of the Danube has been changed at several points by sand blown into its channel by the southeast storm wind, the 'Koschava,' from an extensive area of ridged dunes. The various narrows of the great river and their improvement for navigation are fully described.

THE LOCATION OF SETTLEMENTS.

DR. A. HETTNER, Privatdocent in geography in the University of Leipzig and editor of a new geographical journal, contributes to it an essay on the geographical controls of human settlements, reviewing the previous literature of the subject and laying down lines along which further research should be conducted (Hettner's Geogr. Zeitschr., i., 1895, 361-375). Somewhat as plants and animals are affected in their distribution by geographical environment, so man himself responds to his surroundings; his personal will having a much less influence than would appear at first sight, although complicating the reaction in a manner not apparent in the case of lower organisms. Just as the features of the land are now best explained by an appropriate historical method of study, based on their geological evolution, so the location of settlements should be studied in relation to their development from their beginnings, and not only in relation to their actual surroundings. The article as a whole is an abstract consideration of the subject, without illustration by specific examples.

MIDDENDORFF'S PERU.

A RESIDENCE of twenty-five years in Peru affords Middendorff an extended experience for record in his work on that country, of which the third volume, Das Hochland von Peru (Berlin, 1895), now follows the second, Das Küstenland (1894). The coastal desert belt, with its irrigable valleys, rises into the highland through dull slopes of rock waste, seldom varied with ledge or cliff, but sometimes trenched by great ravines. Ascending this western slope, the traveler finds himself on lofty barren plateaus, of rather cool climate, holding lakes in their depressions; a special account being given of Titicaca and its surroundings. Very different from the barren ravines of the dry western slope are the deep warm valleys of the rainy and forested eastern slope, in which many streams that head west of the eastern range cut their path on the way to the Amazon.

As in so many books of travel, this one, although the work of an interested observer, loses greatly in geographical value from an insufficient understanding of physiography on the part of the author. The control of topographic form by climate, for example, is sketched rather than described, although the Peruvian Andes exemplify it with an emphasis hardly paralleled elsewhere. W. M. Davis.

Harvard University.

SCIENTIFIC NOTES AND NEWS.

ZOÖLOGICAL NOMENCLATURE.

The meeting of the Zoölogical Society of London, March 3d, was devoted to a discussion of Zoölogical nomenclature, under the the leadership of the veteran ornithologist, P. L. Sclater, who presented the claims of the Stricklandian code in comparison with that of the German Zoölogical Society. Strickland's code, that formulated for the British Association in 1842, differs from the later one chiefly in the following points:

1. The German rules disclaim any relation to botany, so that, according to them, the same generic names may be used for a plant and for an animal. This is contrary to the Stricklandian code, which, however, is practically a dead letter, in this particular, after fifty-four years of trial.

2. Under the German rules the same term is to be used for the generic and specific name of a species if these names have priority.

This is contrary to the Stricklandian code, and also to the usage of many American zoölogists, though practiced by those who accept fully the rules of the American Ornithologists' Union.

The German rules adopt the 10th edition of Linnæus's Systema Naturæ as the starting point of zoölogical nomenclature, whereas the other adopts the 12th. The 10th is universally accepted on this side of the Atlantic.

These differences are but trifling, and it is probable that they will all be reconciled through the agency of the nomenclature committee appointed at the Leyden meeting of the International Zoölogical Congress.

THE TORONTO MEETING OF THE BRITISH ASSOCIATION.

Nature states that the Toronto Local Committee are assiduously engaged in preliminary work for the meeting of the British Association for the Advancement of Science in 1897. Meetings of the executive committee are held every fortnight. Besides the executive committee, a number of sub-committees are at work, including those on finance, conveyances, publication and printing, rooms for offices, meetings of the association and committees, hotels and lodgings, press, hospitality, reception and for securing coöperation of other institutes, associations and corporations, postal, telegraph and telephone facilities. The attention of the committee on conveyance has already been called to the desirability of securing from the Canadian Pacific Railroad transportation for such members of the Association as may desire to extend their travels to the Pacific coast, with special reference to the suggestion that a meeting of the American Association for the Advancement of Science may follow the Toronto meeting, if adequate facilities for transportation are assured. This suggestion is based upon the fact that the American Association have already once voted in favor of such a meeting if satisfactory rates could be obtained; and the hope is still entertained that delegates from both British and Australasian Associations might find San Francisco a convenient point at which to meet the American Association. Mr. Griffith, the general secretary of the British Association, is exexpected to be in Toronto about May 22d, to make arrangments for the meeting, and set out the proper lines of work. The chairman of the local committee is Dr. A. B. Macallum.

ENTOMOLOGY.

It has always been assumed that flowers attracted insects, in large measure at least, by the splendor of their inflorescence. Some recent experiments by Plateau, recorded in the Bulletin of the Belgian Academy, throw doubt upon this assumption. In a considerable bed of showy dahlias Plateau concealed from sight the highly colored rays of some of the flowers exposing only the disk, and in a second series of experiments the disk also but independently, either by means of colored papers or by green leaves secured in place by pins. Butterflies and bees sought these flowers with the same avidity and apparently the same frequency as the fully exposed flowers in the same patch, the bees particularly pushing their way beneath the obstacles to reach them, though not always with success. Plateau concludes that they are guided far more by their perception of odors than by their vision of bright and contrasted colors.

IN a second communication to the same Academy Plateau gives the details of another set of experiments to determine whether a wide-meshed net presents any obstacle to the passage of a flying insect which, as far as room was concerned, could easily pass in flight through the interstices. He finds that, while such nets do not absolutely prevent passage on the wing, insects almost invariably act before one they wish to pass as if they could not distinguish the aperture, ending by alighting on the mesh and crawling through. He reasons that through the lack of distinct and sharp vision the threads of the net produce the illusion of a continuous surface, as for us the hatchures of an engraving, seen at a distance.

ASTRONOMY.

THE Royal Astronomical Society have introduced an innovation in their method of issuing the 'Monthly Notices.' These are now to appear in parts, whenever it seems desirable that this should be done. Heretofore the Notices have appeared once each month, so that it has not always been possible to avoid delay in the publication of important papers. It is not intended that there shall be more than one number each month in the future, but this number will be divided, and issued in parts, when necessary.

THE *Astronomical Journal* of March 11, contains an article by Dr. G. W. Hill, on the perturbations of the planet Ceres by Jupiter and the derivation of the mean elements of Ceres.

THE last number of the *Astronomische Nachrichten*, dated February 29th, contains the announcement from Dr. Belopolsky of Pulkowa that he has obtained a series of good measures of the motion in the line of sight of the brighter component of 61 Cygni. The observations were made with the 30-inch telescope. The motion relatively to the sun is found to be —7.3 geographical miles. Assuming a parallax of 0″.5 and a proper motion of 5.″2, allowing for that of the sun, Dr. Belopolsky finds that the actual motion of the star is at the rate of 7.6 geographical miles per second. The direction of the motion in space has a position angle of 61° and makes an angle of 140° with the line of sight.

H. J.

GENERAL.

WE have received from the Huxley Memorial Committee a second donation list containing further subscriptions amounting to £761. The total amount is now £2,300. A sufficient sum being thus guaranteed for the fulfillment of the two first objects of the Committee, 'Statue' and 'Medal' Sub-Committees have been appointed to carry on the details, and designs are now being prepared. For the third object, the foundation of Exhibitions, Scholarships or Lectureships has been proposed. For this a considerable sum will be required, and the efforts of the Committee to raise it are being promoted by the organization of Local Committees in all parts of the world.

A BRANCH of the International Committee to erect the monument to Pasteur has been formed in Washington, under the presidency of Dr. D. E. Salmon, of the United States Department of Agriculture. Among the members are Secretary Langley, Surgeons-General Tryon, Sternberg and Wyman, Dr. G. Brown Goode and a representative to be appointed by each of the scientific societies.

The series of Saturday lectures, complimentary to the citizens of Washington, will be continued during the season of 1896, under the auspices of the Joint Commission, and under the direction of a committee consisting of W J McGee, G. Brown Goode and J. Stanley Brown. The addresses will be delivered in the lecture hall of the National Museum, 4:20 to 5:30 p. m., on the dates specified. The series of lectures for 1896 has been arranged with the view of illustrating the relations of life to environment, especially on this continent; and two courses have been provided, the first pertaining chiefly to vegetal and animal life, the second chiefly to human life in its relations to lower organisms as well as to the inorganic world. The first course is as follows (the second will be announced later):

March 21, *The Battle of the Forest*, B. E. Fernow; March 28, *The Adaptation of Plants to the Desert*, F. V. Coville; April 4, *The Spread of the Rabbit*, T. S. Palmer; April 11, *Insect Mimicry*, L. O. Howard; April 18, *The Persistence of Functionless Structures*, F. A. Lucas.

DR. G. F. BECKER, of the U. S. Geological Survey, sailed, March 14th, for Capetown, to make an investigation of the South African gold fields.

MR. F. W. TRUE, of the National Museum, is engaged upon a study of the antlers of American deer. His monograph of the family of moles is just going to press.

KICKING BEAR, one of the finest representatives of the Sioux tribe, and one of the few thoroughly typical examples of the uncontaminated Indian, was thoroughly modeled and photographed at the National Museum on March 13th, and a full figure to be clad in the costume which he now wears on ceremonial occasions will be constructed.

DR. JOHN S. BILLINGS and Prof. Simon Newcomb have been designated by the Secretary of State to represent the United States at the Bibliographical Conference to be held in London at the call of the Royal Society.

ADMIRAL MAKAROFF, of the Russian Navy, the author of a very important work upon the currents and specific gravity of the waters of the northwestern Pacific, during a recent visit to Washington, at an informal meeting at the Smithsonian Institution, on March 16th, explained his methods and results to a number of gentlemen interested in hydrography and deep sea explorations.

THE astronomical work of Dr. S. C. Chandler, of Boston, and especially his studies upon the variations of latitude, have been recognized by the Royal Astronomical Society of London, which conferred upon him its gold medal at its meeting on February 14th.

LIEUTENANT COMMANDER J. J. BRICE, U. S. N. (retired), who has been nominated by President Cleveland for the position of U. S. Commissioner of Fisheries, is a citizen of California, and has given much attention to the acclimatization of pheasants. He is interested in angling, and was in 1891 employed under the late Commissioner MacDonald to make a reconnoissance preparatory to the establishment of fish-cultural stations on the military reservations of the Pacific coast and the Rocky Mountains. It is not understood that he makes any claim to be possessed of proved scientific and practical knowledge of the fishes of the coast.

A COMMEMORATIVE tablet has been placed on a school in Passy to record the former residence of Franklin at that place, then a suburb of Paris. Addresses were made by M. M. Faie and Guillois.

PROF. WILLIAM LIBBEY, of the department of physical geography of Princeton University, is organizing a second expedition to the Hawaiian Islands. He will be accompanied by a number of students and will be absent from the close of the college year to the opening in September.

DURING February, 1373 volumes were added to the New York State Library, the total number of volumes in the library, including traveling libraries and duplicates, being now 318,964.

THE officers for the New York Academy of Sciences for the coming year are: President, J. J. Stevenson; First Vice-President, H. F. Osborn; Second Vice-President, R. S. Woodward; Corresponding Secretary, D. S. Martin; Recording Secretary, J. F. Kemp; Treasurer, C. F. Cox; Librarian, Arthur Hollick.

FRENCH is to be recognized as the official language at the twelfth International Medical Congress to be held at Moscow in August, 1897. At the general assemblies speeches may be delivered in other European languages. The sectional papers and discussions must be either in French, German or Russian. The exclusion of English will probably interfere with the attendance of members from Great Britain and America.

A SERIES of lectures has been arranged to increase interest in the Inter-State park at the Dalles of St. Croix, Minnesota and Wisconsin. Among the lecturers are Mr. Warren Upham, Prof. Henry L. Osborn and Prof. Conway MacMillan.

THE New York Board of Fire Underwriters, on the basis of a report prepared by Professor Henry Morton, of the Stevens Institute, has resolved not to insure any building in which acetylene gas is regularly used.

A TELEGRAM to the daily papers states that a meteorite, said to be twenty feet in diameter, has fallen on Pine Mountain, which is located on the Kentucky River, about twenty-five miles from Hindman, Ky. A house is said to have been destroyed and the family buried beneath the debris. While no great reliance can be placed on such reports, the one in question perhaps deserves investigation.

WE have received from the publishers J. U. Kern's Verlag, Breslau, and also from the importers, Lemcke and Buechner, New York, the first number of a new quarterly journal, *Centrallblatt für Anthropologie, Ethnologie und Urgeschichte*, edited by Dr. G. Buschan, with the coöperation of the leading students of anthropology, including Dr. D. G. Brinton, Dr. Franz Boas and Dr. W. Hoffman. The present number contains, in additon to a preface by the editor and a short article by Prof. Sergi, reviews of 112 books and articles.

THE Cambridge University Press has in preparation, as the second volume of the Cambridge Geographical Series, 'The Geographical Distribution of Mammals,' by R. Lydekker.

THE Association for Improving the Condition of the Poor has arranged a series of lectures for the promotion of the agricultural, horticultural and dairy interests of Westchester county. At Pleasantville, last week, Mr. George T. Powell spoke on apple culture; Mr. M. V. Slingerland, assistant entomologist at Cornell University, on insects; Prof. J. W. Sanborn, Lower Gilmanton, N. H., on 'Intensive Methods of Eastern Farming,' and Mrs. Ann B. Comstock, of Ithaca, on flowers and their insect friends. In the neighborhood of places such as Ithaca, where agricultural instruction is given, improvement in methods of farming and gardening has taken place, and it is the object of the Association to extend such instruction more widely.

IT is reported that platinum in quantities sufficient to repay mining has been discovered at Swift Water, a small camp at the foot of Buffalo Peek, Colo.

M. PAUL DE HUMY, a French naval officer, has invented a process for solidifying petroleum. It is said that common oil has been converted into a solid block as hard as anthracite coal, and that it will burn slowly, giving off intense heat. A ton of this fuel is said to represent thirty times its weight of coal.

THE Paris Society of Geography, which already possesses a large collection of photographs, requests travelers, missionaries and others to send geographical and ethnographical photographs, especially such as are taken in remote and partly unexplored regions.

UNIVERSITY AND EDUCATIONAL NEWS.

THE annual report of President Eliot, of Harvard University, states that the following gifts and bequests have been made to Harvard University during the past four years:

1891–92	$516,532.20
1892–93	551,136.10
1893–94	182,890.32
1894–95	171,060.92

MISS MARY E. GARRETT, of Baltimore, has endowed a second travelling fellowship of the value of $500 at Bryn Mawr College. The holder, who must have pursued graduate studies for one year at Bryn Mawr College, is enabled to study for one year at some foreign university.

THERE are this year 160 applicants for the twenty-four fellowships annually awarded by Columbia University—75 in the School of Political Science, 42 in the School of Philosophy, and 43 in the School of Pure Science. The candidates in the natural and exact sciences are distributed as follows: Mathematics, 5; mechanics, 1; astronomy, 2; physics, 7; electricity, 2; chemistry, 6; geology, 5; botany, 5; zoölogy, 9; physiology, 1; psychology, 4.

THE convocation of the University of the State of New York will be held on the last Wednesday, Thursday and Friday of June. On Wednesday afternoon the subject for discussion will be 'Aim and Methods in Science Study in Schools below the College,' in which Prof. C. B. Scott, Oswego Normal School; Prof. S. H. Gage, Cornell University, and Prof. C. W. Dodge, University of Rochester, will take part.

DISCUSSION AND CORRESPONDENCE.

EXPERIMENTS SHOWING THAT THE RÖNTGEN RAYS CANNOT BE POLARIZED BY DOUBLY REFRACTING MEDIA.

TO THE EDITOR OF SCIENCE: I have, to-day, made experiments which conclusively show that the Röntgen rays cannot be polarized by doubly refracting substances.

On six discs of glass, 0.15 mm. thick and 25 mm. in diameter, were placed very thin plates of Herapath's iodo-sulphate of quinine. The axes of these crystals crossed one another at various angles. When the axes of two plates were crossed at right angle no light was transmitted; the overlapping surfaces of the plates appearing *black*. If the Röntgen rays be polarizable, the Herapath crystals, crossed at right angles, should act as lead and not allow any of the Röntgen rays to be transmitted.

On the screen covering the photographic plate were cemented the six glass discs carrying the Herapath crystals; also, three discs of glass overlapping so that the Röntgen rays had to pass through 1, 2 and 3 thicknesses of the glass. The screening of these glasses served as standards with which to compare the action of the rays which had passed through one thickness of glass and the Herapathites. On the screen was also placed a square of yellow blotting paper, $\frac{3}{4}$ mm. thick, on which were placed Herapath crystals.

The screen of compressed brown paper was impervious to two hours' exposure to a powerful electric arc light.

On exposing the screen with the six discs and paper square to the Röntgen rays, in three experiments, for $\frac{1}{2}$ hour, 1 hour and for $2\frac{1}{2}$ hours, and developing, *no traces whatever* could be detected of the Herapath crystals on the photographs of the glass discs or on that of the paper square. The contour of the paper was just visible, only by very careful scrutiny. The photographs of the glass discs carrying the Herapathites were circles of uniform illumination; not the least mottling could be detected. Through a magnifying glass these circles appeared with a uniform grain exactly like, in illumination and grain, the photograph of the glass disc having nothing on its surface.

The thinness of these crystals, their powerful polarizing property compared with their thickness, and their low density of 1.8 are the reasons why they do not at all screen (unlike calcite and tourmaline), the Röntgen rays. These well-known facts induced me to make these experiments on Herapathites. They have confirmed in a very satisfactory manner what Röntgen has shown by his experiments, viz., that the X-rays are not polarized by their passage through doubly refracting media.

ALFRED M. MAYER.

COLOR VISION AND LIGHT.

IN the current number of *The Psychological Review* Mrs. C. Ladd Franklin has written some very appreciative words regarding my article on 'Vision' in the new edition of Johnson's Cyclopædia, but takes exception in very considerate terms to two points which may be worth a moment's attention. The first is to the statement that the retinal cones are sensitive to variations of color chiefly. This was written in connection with an enumeration of certain optical defects common to all eyes; and, of course, there was no intention to imply that the cones are insensitive to that combination of color variations which produces the sensation of white light. Indeed, a previous sentence on the same page may be found which does away with all uncertainty. Nevertheless, the word 'specially' may very appropriately be substituted for 'chiefly.'

The second point is of more importance—a protest against the implication that physicists are satisfied with Helmholtz's theory of vision. My statement that "this theory, with slight modification, is now quite generally accepted by physicists," does not assert that they are necessarily quite satisfied with it. Our opinions are confessedly tentative in proportion to the difficulty of settling the matter by crucial experiments. It is safe to say that no physicist expresses his view upon this subject with any approximation to the confidence with which he asserts the truth of Ohm's law in regard to electric currents. He is compelled to base his statement upon authority; for, as Mrs. Franklin very rightly says, "the physicists have nothing to do with a theory as to what goes on in the retina and in the brain." The practical question for him, therefore, is to choose between authorities.

No scientific man who has lived during the nineteenth century has been more successful in widely different fields than Helmholtz. During the last dozen years the words physicist and electrician have become differentiated; but both were applicable to him as a distinguished representative. As a mathematician he had few equals. All physicists regarded him as an exceptionally strong physiologist. Whether their view is shared by the psychologists it would perhaps not be proper for a physicist to say. While the domain of the physicist is now fairly well differentiated from that of the psychologist, it is not yet possible to separate the psychologist from the physiologist. If the physicist has been too ready to accept Helmholtz's view on a purely psychological topic, he is to some extent excusable in view of the high position attained by Helmholtz as an investigator in subjects about which the physicist is by special training capable of forming an opinion. No one will maintain that Helmholtz was infallible; but the aggregate of demonstrated mistakes made by him was so small in proportion to the number of important discoveries accomplished that his record may be safely compared with that of any living psychologist.

Upon what experiments, either crucial or even moderately satisfactory, can the psychologist to-day base any definite conclusion as to what goes on in the retina or in the brain during the act of vision? Can it be confidently said that we are yet much wiser than our grandfathers were in relation to this elusive problem? These skeptical questions are not meant to imply any lack of esteem for the valuable work which has been done in psychology, or of admiration for the great ability that is at present directed toward the solution of the difficulties which the psychologist boldly attacks. In accepting the hypothesis of Young that three different sets of nerves respond to the three fundamental color sensations Helmholtz fully recognized its uncertainty. He considered it equally probable that each fibril might serve for three activities completely distinct and independent of each other. (*Handbuch der physiologischen Optik*, p. 292.) This theory has been found so satisfactory from the physicist's standpoint that it is hard to see what advantage would be gained by rejecting it until something else is presented that can be established on better evidence. The case is quite analogous to the physicist's acceptance of the all-pervading, elastic, incompressible ether as the medium through which physical energy is propagated. The existence of some sort of medium in space has to be postulated as a necessity of thought; its properties we infer from the phenomena which are explained on the given assumption. The acceptance is provisional only; we are ready to abandon it as soon as better evidence is presented in behalf of some other theory. Thus far there has not been even a suggestion of better evidence.

If now the psychologists can all agree upon some theory which is quite as consistent with known facts, and which involves less violent assumptions than does the theory of Young and Helmholtz, the physicists will assuredly be ready to welcome what seems to be new truth. To criticise is much easier than to construct. There is practical unanimity among the physicists just at present, but for the psychologists the same can by no means be said. For some time the leading competitor of the Young and Helmholtz theory was that of Hering—a theory which is less simple, and based on assumptions quite as difficult. But we are now informed that "there is one important university in this country in which the theories of Helmholtz and Hering have both been definitely given up, and particularly in the physical department." Granting this, the physicists elsewhere are justified in asking what they should now accept, and what are the positive grounds for acceptance. Several new theories of vision have been propounded within the last few years. One is by Ebbinghaus (*Theorie des Farbensehens*, 1893); another, which is very attractive, is due to Mrs. Franklin; and still another, by Nicati, has been brought forward within the last few months. This is somewhat bewildering for the physicists, who must be modest enough to wait until the psychologists come to an agreement among themselves. It may be true that the Helmholtz theory is preëvolutionary and prepsychological; but the physicists have their hands too full to stop and examine all these competing theories. To test them is the privilege of the psychologists. Pending the establishment of some one of these new theories by an exhibition of approximate unanimity among the psychologists, the rest of us will be apt to content ourselves as best we may with the theory of vision that has thus far seemed no more objectionable than its successors, and which is fortified by the authority of the greatest German physicist of the nineteenth century.

We are fully aware of certain facts in the history of science that may quite naturally be cited in this connection. The great authority of Newton caused more than a century of delay in the acceptance of the undulatory theory of light. The modification of this theory by Maxwell received but a small share of the credit it deserved until Hertz published the experimental evidence upon which light was shown to be very probably an electro-magnetic phenomenon. As soon as any new theory of visual perception is established upon evidence comparable with that brought out by Hertz, if it conflicts with the Helmholtz theory of vision, this will become of only historic interest, like the emission theory of light. Its fate, however, has not yet been sealed.

In this connection it may be permissible to express my hearty accordance with the views set forth by Mrs. Franklin in a recent contribution to *The Nation* regarding the desirability of greater precision in the use of the word 'light.' The meaning of a word is determined by custom rather than argument. But custom may be gradually modified if those who have occasion most frequently to use a special word or form of expression will agree among themselves to guard against ambiguity. No careful physicist at present includes the ultra-violet or infrared ether vibrations among light vibrations. The distinction between luminous and non-luminous energy waves is generally accepted and applied. But we need to habituate ourselves to the use of the term 'light-sensations,' rather than 'light,' when reference is made to what is carried to the brain by the optic nerve, whether the origin of the sensation is found in luminous, electric or mechanical energy. The American sense of linguistic æsthetics may be depended upon to prevent the adoption of such cumbrous unhyphened compound words as are tolerated by our German friends. But the scientific demand is for clearness combined with accuracy, for an application of the doctrine of conservation of energy in the giving and taking of ideas. Whatever differences may exist between the physicist and psychologist regarding the explanation of light-sensation, they can certainly clasp hands and agree not to deceive each other by unnecessary vagueness in the use of language.

W. LE CONTE STEVENS.

THE PHILADELPHIA BRICK CLAYS, ET AL.

I HAD not thought there was occasion for responding to the article of Prof. G. Frederick Wright (SCIENCE, No. 59, p. 242), until inquiry concerning the truth of the matters touched upon began to be made by correspondents. I shall not now take space to state the case fully, but only to say that the term 'Columbia,' as used by Prof. Wright, and indeed as it has been generally used in the past, is a somewhat ambiguous one. It has been made to cover formations, chiefly extra-glacial, widely separated in time, ranging indeed from the beginning of the glacial period nearly to the present. The Jamesburg formation of New Jersey falls within the limits of the Columbia, according to this usage, but the term Jamesburg has never been extended to the extra-morainic drift discussed somewhat fully in the New Jersey geological report of 1893. Most of the Jamesburg deposits of New Jersey are, I take it, relatively young, as indicated by Prof. Wright's citation from my report. But if I interpret rightly, there are remnants of a much older division of the 'Columbia' formation, not referred to explicitly in the report from which Prof. Wright quotes. These remnants are in scattered patches, and are quantitatively unimportant; but they are, as I believe, very significant. If present interpretations be right, there was very extensive erosion after the deposition of the formation of which these patches are remnants, this erosion antedating the deposition of the great body of material which passes under the name of 'Columbia.' Just where in the complex 'Columbia' the 'Philadelphia brick clays' belong, is a question I have nowhere discussed. While from their general position, I have an opinion as to their age, I have given them too little attention to make it worth while to express that opinion in print. I venture the suggestion, however, that the 'brick clays' may be of various ages. Some of the clays used for brick about Philadelphia (whether 'Philadelphia brick clays' or not is another question) are at low altitudes, and are *younger than the Trenton gravels*, since they overlie them. Others are at much greater altitudes, and are presumptively of different, perhaps very different age. When our work in New Jersey is complete I shall attempt to make as careful a correlation of the various formations, and of their various phases, as the facts at hand shall warrant. Until that time, inferences based on annual reports, which are confessedly 'reports of progress,' are liable to be misleading. Possibly it would be as well not to make them.

Prof. Wright is good enough to refer to the conclusions which I have reached, as a "distinct advance." I, however, do not see any reason to think that my final conclusions are likely to be antagonistic in any important sense to the opinions which I have heretofore held, opinions which are in general harmony with those of Prof. Chamberlin, whose name is brought into the article in question. The most important modification of my own views which has yet taken place is the reference of a larger portion (than formerly) of the Jamesburg to the 'low-level' (younger) division.

I am not personally qualified to speak concerning the Conewango and Allegheny terraces, to which allusion is made; but, if I understand the matter correctly, there has been no abandonment by Prof. Chamberlin and his colaborers of any essential position relative to the phenomena along the Allegheny River. On the contrary, I have been under the impression, all along, that the detailed study of the region had tended to confirm the essential correctness of the position taken by Prof. Chamberlin long ago. ROLLIN D. SALISBURY.

UNIVERSITY OF CHICAGO, March 9, 1896.

PRIMITIVE HABITATIONS IN OHIO.

IN a recent discussion between two ethnologists it was advocated that all tribes living in timbered sections constructed houses of logs, bark or saplings, and that the tepee or skin lodge proper was characteristic of the plains. At Oregonia and Fort Ancient, two points in the Little Miami Valley, in Ohio, are large village sites upon which the sunken depressions marking lodge sites are still discernable. One of these areas has been under cultivation; the other is in its natural state. Some of the depressions are circular (the deeper ones), while the others are irregular. Ashes, charcoal, pottery, bones and implements are found in them to a depth of two or three feet, indicating a considerable excavation for the fireplace of each home. Those which are circular may have assumed such shape by natural agencies, as the wash of the soil into the deepest part of the excavation.

A number of the irregular sites were excavated. While the greatest quantity of refuse was found in the center, yet the debris extended on all sides for a distance of 12 or 15 feet. The site itself would vary from 20 by 25 to 30 by 45 feet, and frequently the ashes, pottery and bones were six or seven inches deep near the outer edge.

No modern relics have been found on either of these spots, although a careful examination (covering many months) was made of each. From the excavations it would appear that the habitations were permanent. At one point, considerably below the surface, remains of small (ends) logs eight inches in diameter were found, but it was hard to determine the character of the habitation.

I am of the opinion that most of the houses were of logs, coated with clay, thus forming 'clay domes' after the fashion of the Mandans. My theory is based upon these facts: The depressions, their extent and character; the fact that the first plowing of the southern part of Fort Ancient revealed circular embankments a few inches high, also irregular and slightly raised masses of reddish clay. When the lodge decayed and fell the upper portion would naturally fall into the entire space enclosed. As the walls immediately above the base were thick, when they fell the circular ring was formed.

The farmers also stated that the clay in these circles was in chunks and hard as if sun-dried or slightly baked.

WARREN K. MOOREHEAD.

QUESTIONS REGARDING HABITS AND INSTINCT.

FOR purpose of extended comparison we wish data as to habits, instincts or intelligence in animals, above all, minor and trifling ones not in the books, *useless or detrimental* ones, and the particular *breed*, *species* or *genus* showing *each.* Examples; Purrings licking; washing face; kneading objects with forepaws, humping back, and worrying captured prey (like the cat); baying at moon (or otherwise); urination and defecation habits (eating, covering up, etc.); disposition of fæces and shells in nest; rolling on carrion; cackling (or other disturbance) after laying; eating 'afterbirth' or young; sexual habits; transporting eggs or young; nest-sharing; hunting—partnerships, or similar intelligent associations; hereditary transmission of peculiar traits; rearing young of other species with resulting modification of instinct; feigning death; suicide; 'fascination' *and any others.* Circular of information will be sent and full credit given for data used, or sender's name will be confidential, as preferred. Answer as fully as possible, always stating age, sex, place, date (or season), species, breed, and whether personally observed.

G. STANLEY HALL.
R. R. GURLEY.

CLARK UNIVERSITY,
WORCESTER, MASS.

NEWLY HATCHED CHICKENS INSTINCTIVELY DRINK.

EDITOR OF SCIENCE: In your issue of March 6, 1896, appears an excellent and accurate note by Wesley Mills, calling attention to an error of statement made by Prof. Morgan in SCIENCE (issue of February 14, 1896).

With due deference to '*The Writer of the Note,*' who follows Mr. Mills, and who says that Morgan's argument is satisfactory—that "a chick might die of thirst in the presence of water," I desire to say that this is not my understanding of the case. I have been, during the last thirty-five years, a breeder of fowls as an amateur, and I have given the hatching and rearing of chickens close and continued attention.

I have repeatedly placed a shallow water dish before the bars of a coop in which a newly hatched brood had been placed the day previous, taken there directly from the hatching nest, and in which they never had food or water offered. Repeatedly, before these small chickens, not twenty-four hours from the shell, and before they had been offered food, I have filled their shallow water tray, and observed them toddle out to it, peck at it, or at once thrust their bills into it, *to drink at once by uplifting their heads*, as all adult fowls do, the hen never putting her head out from the bars, or showing these young chicks how to do what they instinctively did. I have made the same experiments repeatedly with food, with the same result, *i. e.*, that chicks instinctively drink and eat without any example being set by the mother hen.

HENRY W. ELLIOTT.

LAKEWOOD, OHIO, March 11, 1896.

SCIENTIFIC LITERATURE.

Moderne Völkerkunde, deren Entwicklung und Aufgaben. By THOMAS ACHELIS. 1 vol., 8°, pp. 487. Stuttgart, Ferdinand Encke. 1896.

The author of this work is a 'doctor juris' in Bremen, and the writer of several treatises on the development of the modern science of ethnology, properly so called. In the present volume he proposes to define the true aims of that branch of research by an investigation in the first place of its historical development; secondly, of its contents; and thirdly, of its relations to other departments of knowledge.

He expressly states that the words 'Völkerkunde' and 'Ethnologie' mean one and the same science (p. 300), the aim of which is 'to set forth the development of mankind in its different branches and their various stages of culture, and thus obtain, as nearly as possible, a correct picture of a complete and organic whole.' These stages of culture must be regarded as the constituent elements of a continuous mental process or growth, and thus reveal the unfolding of the universal human consciousness.

In this manner, ethnology leads up to philosophy, which thus enters into the category of the inductive sciences, and wins for itself a substantial foundation in objective and experimental truth, through the lack of which, up to the present time, it has failed to render any permanent and serious contributions to human knowledge.

The author draws a sharp line between ethnology and physical anthropology. The former concerns itself with man exclusively as a social being, in his relations to other men, in his life in societies, peoples or nations; the latter finds its proper field in studying the individual, and solely from his anatomical and physical side, strictly excluding psychic phenomena. This distinction, to which the author rigidly adheres, is, we believe, erroneous, inconsistent with natural relations, and a serious blemish in this otherwise excellent construction of ethnologic science. Modern psychology cannot be divorced from physiology and anatomy, neither in the individual nor in the folk; and that Dr. Achelis so constantly underrates their essential connections can be explained only by the fact that his professional studies have been legal and not medical.

In his psycho-physics, he depends chiefly upon Wundt, unquestionably an authority of the first rank, but whose analysis of self-consciousness, and whose rejection of the capacity of self-observation, have been amended by later specialists in this branch. Another point of incompleteness in his developmental theory is the deficient appreciation he manifests of the relation of degeneration to progression. Indeed, he would exclude retrogressive metamorphosis from the primary factors of social evolution; whereas, it is an indispensable condition of such evolution in most, if not all, instances, just as it is in organic forms.

Having thus set forth the author's theoretical positions, the method of their presentment may be considered.

The science, he argues, began with ethnographic pictures, such as those offered by Lafitau and Cook, which were worked up politically by Montesquieu, Rousseau and others, philosophically by Herder and Schiller, geographically by Ritter and Reclus, etc. These gave the foundation for ethnology as the science of sociology, in which the names of Spencer, Quatrefages, Bastian, F. Müller, Waitz, Tyler, Post and others are familiar to most readers. Three hundred pages of the volume are devoted to careful epitomes of the labors of these scholars, and then the author feels himself ready to present his own definition of ethnology and description of its aims. These have already been briefly mentioned, and it is enough to add that he supports them by an analysis of the material and intellectual culture of humanity, such as arts, languages, religions, laws, commerce, etc.

The third division of the treatise exhibits the bearings of ethnology on other sciences, especially geography, archæology, history, religion, philosophy and sociology. It is brief, not forty pages in all, and unsatisfactory. It shows signs of haste and inadequate treatment, as anyone can see by reading the three pages on anthropogeography.

In spite of the defects which we have freely pointed out, the work as a whole is admirable, breathing the spirit of advanced thought, representative of the leading school in the study of man, and rich in suggestions for further investigation. The style is clear, the language forcible, and the presentation popular. It deserves a marked success.

The Child and Childhood in Folk-Thought. (*The Child in Primitive Culture.*) By ALEXANDER F. CHAMBERLAIN, M. A., Ph. D., etc. Pp. 464. New York, Macmillan & Co. Price, $3.00.

This work supplies a want in the literature of folk-lore, and supplies it well. It must have been a pleasant occupation to the author to collect the mass of material he presents us, from the family and folk-talk of all times and all peoples, to illustrate how they regarded the little creature, the child, for whom alone, indeed, the family has any reason of existence.

It is astonishing to note what an important part he has played in the life and opinions of his elders, and what diverse powers he has exhibited or been credited with. Two hundred pages of the book are filled with descriptions of the child as a builder of society, as a linguist, actor, poet, teacher, judge, oracle-interpreter, weather-maker, healer, priest, hero, fetich, divinity, God. Six chapters are filled with the proverbs, sayings and saws about the child in its various relations to the family; and the volume opens with three chapters replete with attractive examples of the child's tribute to its mother,— delightful exemplifications of the deep and holy impress which maternal love has left on the soul of the race.

Childhood is spoken of as the golden age of life, 'a moment of God,' 'a time of June,' its days as 'halcyon days,' a 'heaven on earth;' a belief, says the sanguine author, 'shared alike by primitive, savage and nineteenth century philosopher.' We wish, indeed, this were so; but, alas! our own observation is that out of a dozen persons asked, ten will tell you that the period of their childhood was by no means the happiest portion of their lives. In sad truth, the golden age of childhood is as much a popular delusion as the golden age of the world. We think of it as such merely because we forget the numberless little miseries which we then endured, and which at the time were grave and great to us.

But apart from this question of fact, about which the author's opinion in no wise injures the excellence of his labors, the thorough sympathy he has with children, their thoughts and doings, beautifies his pages and renders them charming reading as well as sovereignly instructive. He is no gleaner of dry stubble, but delights in the literary and poetic sides of his inquiry, and brings under contribution the bards, the dramatists and the moralists of the world. His reading has been wide, and not at second-hand, or through translations, but in the originals of a dozen tongues; as we might expect from one who has already made his mark as a comparative linguist.

A most useful bibliography of 549 titles and two ample indexes close his volume, and add vastly to its value to the serious student of folk-lore.

D. G. BRINTON.

Practical Inorganic Chemistry. By G. S. TURPIN. London and New York, Macmillan & Co. 1895. Pp. 158+viii.

This little book is evidently intended for the use of pupils in secondary schools. The first four chapters contain directions for weighing and measuring solids and liquids, for determining specific gravity, for measuring gases and observing their behavior under changes of temperature and pressure. The study of chemical action begins with an examination of the effect of air upon different metals. In these experiments the students find out that the balance is of very great service in interpreting the nature of chemical changes. The results of one experiment suggest the making of another experiment and so the work goes on step by step until the pupil finds it possible to separate the active and inactive constituents of the air and this leads him naturally to a determination of its volumetric composition. Oxygen and nitrogen are then studied more thoroughly and a quantitative analysis is made of potassium chlorate. Water and hydrogen are examined in a similarly thorough manner, and in connection with the latter the equivalent weights of a number of the metals are determined.

Only a few of the more common nonmetallic elements are dealt with. The chief merit of the book lies in this, that due attention is everywhere given to the quantitative side of chemical phenomena. It is shown how with very simple apparatus beginners can determine the relative quantities of substances that interact, and can acquire a knowledge of important laws of the science. The only criticism that might be made is that the apparatus and methods used in some of the quantitative work, as, for instance, in measuring gases by the volume of water displaced, are so very simple that by means of them only roughly approximate results can be obtained. An improvement in this direction would be made by collecting the gases in graduated gas measuring tubes, and correcting the gas volumes for the tension of aqueous vapor.

Taken altogether, the course of laboratory work here given is a most excellent one. It is refreshing to meet with a laboratory manual that is not simply a collection of qualitative tests for substances. This little book can be heartily recommended to all who are engaged in teaching elementary chemistry.

E. H. KEISER.

Chemical Experiments—General and Analytical. By R. P. WILLIAMS. Boston, Ginn & Co. 1895.

The author has arranged this course of chemical experiments for students in high schools, academies and colleges. In the first half of the book the usual experiments upon the preparation and properties of the non-metallic elements are given, while the latter half consists of a series of analytical tables giving the behavior of solutions of metallic salts under the influence of the various reagents. The laboratory directions in the first part are upon the whole clearly stated, but they are marred by the excessive use of abbreviations and formulas. For example, in experiment 34 the student is directed to "connect the flask with a large t. t. or with a rec. which contains no water, and from this t. t. or rec. have a d. t. leading to a p. t. so as to collect the gas over water." In the introduction, page xi., the students are instructed to keep notes in the following way: "I, ———, put the mixture into a t. t., adjusted a d. t., hung it to a r. s., and arranged so as to collect the gas in recs. over water in a p. t." Nearly everywhere in the book symbols are used instead of the names of substances. Surely to encourage pupils to imitate this example is to confirm them in slovenly habits.

Another feature of the book to which exception must be taken is that entirely too much attention is given to 'tests.' The main idea seems to be to give the 'tests' for each substance, and a pupil taking this course would most likely get the idea that practical chemistry consists in finding the 'tests' for various substances. There is not in the whole course a single experiment which serves to elucidate any one of the fundamental laws of the science.

Such a method of teaching chemistry to beginners cannot be recommended. Instead of teaching them to distinguish ferrocyanides from ferricyanides, tartrates from oxalates, it would be much better for them to study the chemistry of common things, of air, water and fire, and this study should not be confined to the qualitative side of the phenomena observed. It is not impossible to teach beginners how certain chemical changes can be studied quantitatively and to arrange a course of experiments for them so that they shall acquire some knowledge of the chief laws and principles of the science.

E. H. KEISER.

Einführung in die mathematische Behandlung der Naturwissenschaften. Kurzgefasstes Lehrbuch der Differential- und Integralrechnung mit besonderer Berüchsichtigung der Chemie. By W. NERNST and A. SCHÖNFLIES. München und Leipzig, E. Wolff. 1895. Pp. xi+309.

One of the authors of this book, W. Nernst, is professor of physical chemistry at the University of Göttingen; his collaborateur, Professor Schönflies, is attached to the department of mathematics at the same seat of learning. This union of forces has been a fortunate one, for the writers have certainly succeeded in carrying out their intention of facilitating the study of the higher mathematics for students of natural science.

The keynote of the authors' purpose is sounded in the following lines, which they introduce in their preface as a quotation from H. Jahn's recent publication on electro-chemistry: "Even chemists must gradually grow accustomed to the thought that theoretical chemistry will remain for them a book with seven seals, unless they shall have mastered the principles of higher mathematical analysis. A symbol of differentiation or integration must cease to be an unintelligible hieroglyphic for the chemist * * * if he would not expose himself to the danger of losing all understanding of the delopments of theoretical chemistry.

"For it is a fruitless endeavor to attempt, by lengthy descriptions, to elucidate—even partially—that, which an equation conveys to the initiated in a single line."

The opening chapter discusses the principles of analytic geometry. After a few introductory remarks on graphic methods of presenting experimental results, and after having referred to the axes of coördinates, abscissa and ordinate, quadrants, etc., loci and their equations are considered. The circle, the parabola, the straight line, the ellipse, receive due attention, examples and problems being given to illustrate the discussions.

The second chapter is devoted to the fundamental principles of differential calculus. The introductory paragraph of this chapter —on the principles of the higher mathematics and the methods of consideration employed in the natural sciences—is well worthy the perusal of any scientist, no matter in what direction his interests may be enlisted.

Following this are chapters on the differentiation of simple functions; integral calculus and its applications; higher differential equations and the functions of variables; infinite series and Taylor's series; the theory of maxima and minima; solution of numerical equations; examples from mechanics and thermo-dynamics. Collections of problems and formulæ precede the index, which completes the volume.

The aim of this book is fully expressed by its title; its scope is indicated by the above summary of its contents.

Although not a pioneer in this particular field—A. Fuhrmann's Naturwissenschaftliche Anwendungen der Differential-rechnung was published in 1888, the appearance of this treatise must be pronounced most opportune. It is certainly deserving of a cordial welcome, and mastery of its contents can not fail to be of great value to all who have not already appreciated the important bearing of the higher mathematics on numerous problems of natural science. FERDINAND G. WIECHMANN.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—257TH MEETING, SATURDAY, MARCH 7.

A PAPER on *the Influence of Fruit-bearing upon the Mechanical Tissue of the Twigs*, by Adrian J. Pieters, was, in the absence of the author, read by George H. Hicks. The author's conclusions, based on a study of twigs of the apple, pear, peach and plum were that the one-year-old fruit-bearing shoot of the apple and the pear has less wood in proportion to its diameter than does the vegetative shoot of the same age. This is due, in the apple largely, and in the pear solely, to a great increase in the cortex of the fruit-bearing shoot. It does not, however, appear from the structure of the shoots that the fruit-bearing shoot is weaker than the vegetative. The former is well supplied with supplementary mechanical tissue which is distributed at those points where it is most needed. This gives an increase of strength for the fruit-bearing year, which fully makes up for the small difference in xylem. In the peach the fruit-bearing shoot has more wood than the vegetative, and the walls of the wood cells are as thick in the former as in the latter.

In general it may be said that the effect of fruit-bearing upon the tissues is local. In the apple and pear it is felt throughout the one-year-old shoot; in the plum and peach it is confined to a small area in the immediate neighborhood of the fruit stalk.

The local effect on fruit-bearing is towards an increase of cells and a decrease in the thickness and lignification of the walls of the wood cells. The cortex is especially enlarged, giving rise in the apple and pear to the characteristic swollen condition of the fruit-bearing shoot.

In all cases the increase in growth is greatest on the side near the fruit stalk, although the wood in the apple and pear is best developed on the side of the lateral vegetative bud.

The effect which fruit-bearing exerts upon the xylem disappears with time. The study of apple shoots that had borne fruit in their first year showed that in the two or four years following there had been a rapid increase of wood, especially on the side of the fruit scar which was weakest at the end of the first year. At the end of three and five years these shoots had a better xylem development than shoots of the same age that had never borne fruit.

Fruit-bearing has a local effect upon the lignification of the walls of wood cells. It prevents their lignification wholly or in part according to their distance from the fruit stalk.

The lignification of other cell walls is promoted by fruit-bearing. In the fruit stalk the greatest part of the tissue has become lignified, and in the upper part of the apple and pear shoots there is an abundance of sclerenchyma and hard bast, which is either not found in the vegetative shoots or only in small amounts.

Dr. E. L. Greene presented a paper on *The Distribution of Rhamnus and Ceanothus in America.* Of the first named genus, the European *Rhamnus cathartica* being its type-species, some 100 species are recognized, these being distributed all around the northern hemisphere, chiefly within the temperate zone. In contrast with Europe, which has 23, North America north of

Mexico is poor in species, not more than 12 or 14 being credited to our territory. Four of these are of the Atlantic slope of the continent, the rest belonging exclusively to the Pacific slope. That narrow strip of territory intervening between the crest of the Sierra Nevada and the Pacific has more than twice the number of Rhamnus species exhibited by all the vast area of the United States besides. Each one of the far-western species occupies an altitudinal belt of its own, never trespassing upon the territory of another species; *R. Californica*, for example, inhabiting the Coast Range hills, from near the level of the sea up to an elevation of several hundred feet. In the dry interior region lying between the two mountain chains, *R. tomentella* holds the field as exclusively, this at altitudes varying from 300 to 3000 feet. Then, after passing the region of this shrub of the dry interior, and reaching an altitude of about 5,000 feet, where there is deep annual snowfall, there occurs a narrow belt of an exceedingly distinct species, *R. rubra*; this shrub being deciduous, while both its allies of the lower altitudes are evergreen.

Ceanothus, the genus of shrubs, most nearly allied to *Rhamnus*, instead of being like that, almost cosmopolitan, is confined to North America; where only 4 out of the whole number of more than 60 sorts are of the Atlantic slope; some 6 belong to Mexico and Arizona; all the remaining 50 occurring within the limits of the State of California; no fewer than 40 of them being strictly limited to that State, where the Coast Range seems to be the special home of the genus.

The two eastern species, *C. Americanus* and *C. ovatus*, which are the type of the genus, have but one near ally, and that is the far-western *C. sanguineus*. The two Floridan species, *C. microphyllus* and *C. serpyllifolius* are in affinity far removed from the other Atlantic species, and are separated from their only near relatives, certain species of the Californian Coast Range, by a distance of more than 2,000 miles. Again, one species peculiar to islands near the California coast is related to none of the species of the closely adjacent mainland, but has its near kindred more than 1,000 miles southward, in central Mexico.

Frederick V. Coville spoke of *Different Editions of Some Government Expedition Reports*, stating that several editions of the reports of the expeditions of Emory, Stansbury and Fremont had been published, and that not only were there differences in the pagination, but, in some instances, changes in the text, these alterations in some cases affecting the specific and even generic names of plants. Anyone quoting from these reports, the speaker said, should be careful to state exactly which edition was referred to.

F. A. LUCAS,
Secretary.

THE WOMAN'S ANTHROPOLOGICAL SOCIETY.

THE 140th meeting of the Society was held February 29th, the day being devoted to Archæology. Miss Sarah A. Scull gave a talk on the growth of Art in Egypt, Chaldea, Assyria and Greece, and comparisons were drawn between Semitic and Aryan arts. All sections of the Society, in their studies, are looking especially towards this point—differences in the two families, Semitic and Aryan—and many interesting comparisons have been drawn in the section meetings as well as in those meetings that have been open to the public. Miss Scull's remarks were illustrated by stereopticon views, many of which were from photographs taken by herself.

The meeting of March 14th was in charge of the section for Child-Life study. Mrs. Eudora Lucas Hailmann, who has devoted her life to study of the child in the Kindergarten, presented her views on the use of symbols in early education. In the treatment of the subject, the address had reference entirely to children of the age from three to seven inclusive. Normal, vigorous children of these ages do not speculate, do not dream day dreams, do not see sprites in the flowers, nor ogres in the forest, unless they have been put there by older heads. Their eager, active, healthy minds and bodies are too much absorbed in the immediate interesting beautiful wonders that surround them. There is no need to stimulate their love and admiration for life by artificial means, and they have not reached the contemplative, speculative age of abstract thinking. To force this upon them at this period of development is to make them precocious, and consequently, to arrest development and to rush them into degeneracy. The child, if left to himself, will discover symbolism in nature. When it is given to him ready made it has a tendency to render him superstitious, credulous and superficial. During these specially sensitive years of early childhood impressions should be pure, clear, direct and complete. The brain, at this period, is more susceptible and much more active, consequently much more intensely conscious, that in later life, eagerly clinching every new impression in order to make use of it in giving expression to its own individuality, which has become firmly rooted in the loves and lives of its environment. The thought centers for this period should be full of instruction and abound in beautiful sentiment.

There is current a doctrine that in each child there are repeated the various phases of development in the life of humanity. It should be remembered, however, that the earlier stages of development, through which the child must pass, are meant, by the very laws of evolution, to sink into rudimentary conditions. To emphasize them must result in arrested development and retard the progress of the race. Education should treat them in such a way as to reduce to a minimum their influence in the life of the child and to assist him to use all his strength in living intelligently toward the ideals of the race. The crudities and superstitions transmitted to us in the myths and allegories of past ages can stimulate only crudity and superstition in the minds of little children whose mental development is not sufficient to enable them to see and appreciate their latent truth and beauty. To force such myths and allegories upon children at too early an age will, on the one hand, subject them in later years to painful struggles to overcome morbid tendencies, and, on the other hand, will blunt their sensibilities to the truth, beauty and love in their environment. Moreover, when persons tell such myths and allegories to little children they labor to adapt them to the children's understanding, in what they call simpler language, and mar both the story and the child.

A. CARMAN,
Secretary.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA., FEBRUARY 10, 1896.

A paper entitled 'Summary of New Liberian Polydesmoidea,' by O. F. COOK, was presented for publication.

General Isaac J. Wistar called attention to the apparently capricious distribution of iron oxide as coloring matter in the rocks of the anthracite coal region. A section in Lykens Valley, for example, shows a thick stratum of red shale below the carboniferous series. It is overlaid by thin green sandstones, the color of which is due to another oxide of the same metal. Upon this rests the thick masses of the Pottsville conglomerate, a white quartzite which shows no coloration from iron, except perhaps a slight external tinge on the enclosed quartz pebbles. Above the conglomerate we find intercalated among the sand stones of the coal measures sixteen coal seams of varying thickness, of which the lowest three show a red ash, several below them a white ash, while the upper three return to a red or pink ash. Above the coal measures there are no signs of iron coloration until, in other localities, the Trias is reached, when we find the red coloring as pronounced as in the carboniferous shales.

These several strata cover a long period in geological history and exhibit the following phenomena: During the red shale period the presence of iron oxide was sufficient to give a high color to the entire deposits. During the still longer period of the conglomerate the available iron, having been all distributed in the red shale, did not appear at all and the conglomerate beds show none. In the deposit of the three lowest seams a fresh supply of iron appears, enough to color their mineral constituents red. Then ensued a long series of coal seams containing little or no iron, to be followed by several red-ash seams near the top of the series. There is then an entire absence of iron in sufficient quantity to color the rocks, until, when the Triassic period occurs, evidences of the universal distribution of iron oxide are more abundant than ever.

These facts appear to show several points during which the accessible supply of iron was exhausted by complete distribution in the strata under process of deposit, with intermediate and subsequent periods during which new supplies appear from some source not yet clearly explained.

Prof. Amos Peaslee Brown stated that it had been suggested by Russell that the red color of certain formations may have originated from the subaërial decay of iron-bearing rocks and the subsequent deposit of this material as sediment forming the red rock. Such rocks as contain iron, especially limestone and the metamorphic schists, would weather in the atmosphere to reddish clays, and during periods when denudation of the surface was not active, or when the land remained at constant level, such weathered accumulations could form to considerable depths. A rise of land level would cause denudation of this accumulated red soil and result in deposit elsewhere. The periods preceding the formation of the Mauch Chunk red shale and the New Red or Trias were such periods of quiescence and they were followed, in the first case locally and in the second generally, by elevation of land causing denudation to be set up and accumulation of red clays to be formed.

So far as the ash of coal is concerned, it is probable that the color is due to the way in which pyrite is contained either in the coal itself or in the slates adjoining. Coal containing separable pyrite would give white ash, while if the pyrite is intimately mixed in the coal the ash will be red.

The subject was further discussed by Messrs. Heilprin, Willcox, Goldsmith and Lyman.

Mr. Jos. Willcox and Prof. Angelo Heilprin commented on the evolutionary value of the large collection of Fulgurs presented at the last meeting, the former claiming that about twenty-five species had been reduced, by the presence of complete series of intermediate forms, to three or four.

EDW. J. NOLAN,
Secretary.

NEW YORK SECTION OF THE CHEMICAL SOCIETY, MARCH 6, 1896.

THE papers presented were:

The Cassel-Hinman Gold and Bromin Process: P. C. McILHINEY.

The Specific Gravity of Glue Solutions: E. R. HEWITT.

Investigations in the Chemistry of Nutrition: W. O. ATWATER.

Mr. McIlhiney enumerated the advantages of bromin over chlorine in the gold extraction process, as (a) greater solubility in water of bromin, 3.2 per cent. against 0.76 per cent. of chlorine; (b) lesser oxidizing power, whereby the iron pyrites is less acted upon; (c) greater solvent power of bromin for gold.

The bromin is recovered by distillation with live steam in stone tanks, after addition of sulphuric acid and an oxidizing agent, as permanganate of potash.

The process is especially adapted to the treatment of low grade telluride ores which have not hitherto been profitably worked.

Mr. Hewitt in his work on specific gravity of glue solutions had obtained his results from experiments on twelve different grades of glue, from the best photographic gelatine to the darkest and poorest grades in the market. He finds the expansion of glue solutions to be the same as water alone; that the specific gravity of glue containing moisture is less than of glue in the dry state; that the hydrometer could not be used in solutions containing over 65 per cent. glue, and that the specific gravity is independent of the quality of the glue.

He concludes that there is a series of distinct chemical combinations of glue with water.

Dr. Atwater described the recent work under his direction at Middletown, Conn., in determining the heats of combustion or fuel values of foods. He said that 'we know the laws of the conservation of energy hold good in the living organism, but we do not yet know *how* they held good. We must study these things in the living organism, and for this purpose a 'respiratory calorimeter' has been constructed of copper, large enough for a man to remain in for some time, and by which the experimental determination of heat of radiation, energy of food consumed, etc., is to be carried out.'

Experiments lasting four days had recently been made, and it was expected to arrange to keep a man in the apparatus by the week.

Eight attendants were required to conduct these experiments, four by day and four by night, keeping temperature records, weighing the food, making analyses, etc.

In reply to questions as to effect of food on the quality of the fat, Dr. Atwater stated that experiments made on dogs had conclusively proved that the fat formation is a function of both the organism and the food.

DURAND WOODMAN,
Secretary.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, FEBRUARY 18, 1896.

1. *An Occurrence of Theralite in Costa Rica.* By J. E. WOLFF. To be published in Amer. Jour. Sci., April, 1896.
2. *The Harvard Meteorological Stations in Peru.* By R. DEC. WARD.

In 1887 a considerable sum of money was left to Harvard College Observatory by the will of Mr. Uriah A. Boyden, to aid in the establishment of an observatory "at such an elevation as to be free, so far as practicable, from the impediments to accurate observations which occur in the observatories now existing, owing to atmospheric influences." In order to select the best possible location for the new observatory, expeditions were undertaken, in 1888 and 1889, to Colorado and California, where astronomical work of various kinds was done at a number of different places. None of the stations thus temporarily occupied proved entirely satisfactory, and it was finally decided to establish the new station in Peru, where Messrs. S. I. and M. H. Bailey had, in the mean time, obtained some excellent results in connection with astronomical work done by them for the Harvard College Observatory on Mt. Harvard, in Peru. The expedition which was sent out to build the new observatory left the United States, under the direction of Prof. Wm. H. Pickering, in December, 1890, arriving at its destination the middle of the following January.

The meteorological advantages for astronomical work in the region selected for occupation are very great. The temperature seldom falls below 40° and seldom rises above 75°. The rainy season is very short, and but little rain falls, generally less than four inches. November marks the beginning of the cloudy season; December is fairly clear, and January to March are cloudy and rainy. During the rest of the year the atmosphere is very dry, and the sky prevailingly clear. In the rainy season it by no means rains every day, there being often a week or a fortnight during which no rain falls. The excessive dryness of the climate, in which vegetation is maintained only by constant irrigation, the short rainy season and the small amount of cloudiness combine to make this a most favorable region for astronomical work.

There are at present eight meteorological stations in Peru, maintained by the Harvard College Observatory. The principal one is at Arequipa, where the observatory is situated at an altitude of 8,050 feet above the sea, and about 80 miles from the coast. The city itself is situated in a little oasis formed by a river valley at the foot of the Cordillera, a little above the lower-lying desert. At Mollendo, on the seacoast, there is a meteorological station 85 feet above sea level. Between Mollendo and the main station at Arequipa, another station has been established, at La Joya, about in the center of a rainless, barren region, and at an elevation of 4,140 feet. The most interesting station of all is that on the summit of the volcano El Misti, 19,200 feet above the sea, lying northeast of Arequipa, about ten miles distant. This station, established after much hardship and maintained with considerable difficulty, is now the highest meteorological station in the world. Mr. S. P. Fergusson, of Blue Hill Observatory, Massachusetts, has recently constructed a meteorograph for the Misti, which records automatically temperature, pressure, humidity, and wind direction and velocity, and will run three months without rewinding. This instrument will obviate the necessity of the frequent visits now made to the summit by the observers at Arequipa.

The other stations are as follows: Flank of El Misti, 15,700 feet, about the altitude of Mont Blanc; Alto de los Huesos, 13,400 feet, a high desert plateau east of El Misti; Cuzco, between the eastern and western Andes, 16,100 feet, and Santa Ana, east of the Andes, in the Urubamba Valley, 3,400 feet above the sea.

This continuous line of stations, reaching from the coast inland over 350 miles, and including such great altitudes as the summit and flank of

El Misti, is equalled nowhere else in the world, and the results which the data there collected will furnish are certain to be of the greatest importance to meteorology.

MARCH 3, 1896.

Geography and Geology for Training and Elementary Schools. By R. E. DODGE.

A teacher in a training school for teachers has before him a double task, especially if his subject be one that can also be taught to the children. The teacher of geography and geology has such a specialty, and hence the requirements upon his abilities are somewhat general and diversified. He must, on the one hand, give to the students preparing under his guidance to become teachers, such a scientific understanding of the principles of the sciences that they can go out into active teaching well equipped for their work. On the other hand, he must see that the children in the elementary schools, which are now usually attached to training schools for purposes of observation and practice by the would-be teachers, are given the principles of geography and geology in a way that best illustrates the principles of matter and method he is presenting to his students. In both cases he should recognize that the matter presented should be scientifically treated and scientifically accurate, the method of presentation varying so as always to be adapted to the minds of the pupils.

The would-be teachers must, from the usual inadequacy of their previous training, be well drilled in the principles of the sciences before they are given conceptions of the methods of adapting the matter of the sciences to the younger children. The scientific spirit of interest and inquiry and of rational imagination should be developed as strongly as possible, that the teacher may impart such a spirit to the pupils under her, no matter what their age.

Inasmuch as geography is the most important of all the sciences to be taught in the schools, the teacher should be given only so much geology as would make her best understand the principles of geography. The treatment of geography should give the facts, related in a rational and scientific way, so that she gains not only matter, but the ability to adapt to her own needs any matter that she may be called upon to use.

A teacher thus equipped scientifically, so that she understand the underlying principles of geography, physical, political, descriptive and commercial, can adapt herself to the conditions she meets, so as to become more than a repeater of the matter contained in text-books. Text-books then become, as they should be, suggestive sources rather than complete repositories of matter.

If the principles of geography are presented to the children in the same scientific way, so as to arouse them to observation and investigation, their interest is at once increased, the whole science becomes alive to them, and they are eager to go on and to learn more.

A course in geography for schools should be graded, scientific, and framed so as to impart an understanding of and a love for nature. It should begin with a conception of the processes shown in the daily and seasonable changes about the home. With that as a basis, the child can be lead to an understanding of the other parts of the world, both similar and dissimilar, and becomes more appreciative of the form and meaning of the earth's features. By building little by little upon such a beginning, the pupil can, in the eight years previous to the high school, gain a conception of the relation of man to the geographic features, such as can be rarely if ever given by the method of teaching geography as something to be memorized.

In a course that includes geography, in its many aspects, botany, zoölogy and meteorology, it is possible to give the child a large amount of locative and descriptive geography, and an understanding of the reasons for the customs, habits and development of the great nations; for the routes of commerce and explorations, etc., etc. In this way the child gains an understanding of the world and an ability to interpret the world for himself, that will be of great service to him even after he has forgotten many of the details that he may have memorized. He gets an ability to make use of his powers in adapting himself to new conditions, such as he could never get were the science only taught as a subject for memorizing and not for reasoning.

In the whole course for teachers, if the matter, method and the scientific spirit be kept in mind, the teachers go to their work with a liking for it which is not gained otherwise. A course in geography for teachers and children along the lines suggested above has been planned and is now in operation in the Teachers' College, New York City, and though it is in its first year of operation the result is very pleasing, and the promise for future good results is most encouraging. The constantly increasing interest, as well as understanding, of the children shows that the conception that physical geography can not be profitably given to young children, is erroneous. If it is given in a way to arouse them to thought it becomes a means of drill that is of great service, and that develops more of their powers than if they were simply required to do a lot of memorizing of description and location, without any scientific underlying thread connecting the various topics considered.

Experiments imitative of Glacial Esker and Sand-Plain Formation. By C. W. DORSEY.

A preliminary account was given of a series of experiments performed under the direction of Mr. T. A. Jaggar in the Laboratory of Experimental Geology. The object of the experiments is to reproduce in miniature the conditions of delta deposition at the mouth of a subglacial cavern, with a view to systematic study of the conditions that govern the form of deltas, the arrangement of bedding in cross-section, the development of lobate margins and the influence of variations in stream velocity, coarseness of material and water level. The apparatus used consists of a tin half-tube whose cross-section has the form of an inverted U, and this is longitudinally bent into somewhat serpentine form, to imitate a subglacial stream cavern; a funnel soldered at its upper end supplies load, and a rubber tube from the hydrant supplies the current. Thin sheet lead is bent over this apparatus to represent roughly the form of a glacier front, and the whole is arranged in a large square tank. On starting the current, sand, fine gravel and mixtures of sand with plaster are fed into the funnel and are deposited in a fan delta at the cavern's mouth. The structures obtained may be photographed at any stage, and at the end of each experiment the imitation cavern is removed to show the deposit that represents the feeding esker. On slicing the deltas horizontally and vertically the progressive stages of growth are beautifully shown by the white plaster layers, and in this way migration of the lobes and of the frontal scarp of the delta, as well as the arrangement of cross-bedding, back-set beds, etc., may be traced. An attempt with ice is in preparation, to test the effect of the melting away of the ice on the resultant forms.

The results of these experiments will be offered for publication in the near future, probably in the Journal of Geology.

T. A. JAGGAR, JR.,
Recording Secretary.

NEW BOOKS.

The Life and Letters of George John Romanes. Written and edited by his wife. London, New York and Bombay, Longmans, Green & Co. 1896. Pp. viii+360.

Grundriss der Krystallographie. DR. GOTTLOB LENCK. Jena, Gustav Fischer. 1896. Pp. vi+252. M. 9.

Elements of Botany. J. Y. BERGEN. Boston and London, Ginn & Co. 1896. Pp. v+57.

Voice Building and Tone Placing. HOLBROOK CURTIS. New York, D. Appleton & Co. 1896. Pp. xii+215. $2.00.

The Whence and Whither of Man. JOHN M. TYLER. New York, Charles Scribner's Sons. 1896. Pp. xv+312. $1.75.

The Dynamo. S. R. BOTTONE. London, Swan, Sonnenschein & Co., Lim.; New York, Macmillan & Co. Pp. 116. 90 cents.

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Experiments in General Chemistry and Notes on Qualitative Analysis. CHARLES R. SANGER. St. Louis. 1896. Pp. 49.

Laboratory Experiments in General Chemistry. CHARLES R. SANGER. St. Louis. 1896. Pp. 59.

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SCIENCE

FRIDAY, APRIL 3, 1896.

CONTENTS:

MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*EXPEDITION TO SERILAND.**

BY the Spanish explorers and evangels, most of the territory lying west of the Sierra Madre and south of Gila river, in what is now western Sonora and southwestern Arizona, was called Papagueria, or land of the Papago Indians. The eastern and northern boundaries of the area were fairly defined, but the western boundary was vague. Toward the mouth of Colorado river the Papago country was separated from the Gulf of California by an arid tract of volcanic debris known as Malpais, a tract too utterly barren for habitation, traversed by the Indians only on annual pilgrimages to the coast for salt. Toward the south, Papagueria was separated from the Gulf, midway of its length, by the land of the Seri Indians, a tract peculiarly protected from invasion by natural conditions and defended against invaders by a warlike people.

As exploration and evangelization grew into settlement, the Spaniards affiliated with the natives, and a Mexican population and culture pushed into Papagueria; and to-day most of the valleys occupied of old by the Papago Indians are given over to Mexican villages, ranches, and stock ranges, only scattered groups of the aboriginal landholders remaining in Sonora, though their tenure is better maintained in Arizona. With the conquest of Papagueria, explorers

*Read before the Philosophical Society of Washington, February 15, 1896.

pushed over the Malpais and a difficult trail was laid to California, then essentially a part of Mexico; and later, as American enterprise pushed toward the Pacific, another trail was pushed out, in part along the older one, and trod by pioneers until better routes were found along the Gila and further northward. The trails, Mexican and American, pass by the only known waters of the Malpais; and knowledge of the few widely separated tinajas* and springs was bought at the price of many lives. But while the Malpais was thus explored, albeit at great cost, Seriland was protected by a barrier desert and its savage owners so completely that the tide of exploration was practically checked; and Seriland remained unknown, save as to its coast, and except in a vague way as the home of a blood-thirsty tribe from time immemorial.

During the autumn of 1894 an expedition was conducted by the Bureau of American Ethnology through Papagueria and into the border of the Seri country for purposes of ethnic and collateral research; during the past autumn an expedition of related aim was conducted along other lines through Papagueria and into Seriland, which was thus for the first time explored and surveyed with some degree of thoroughness. The primary purpose of the later expedition was the making of collections representing the habits and customs, and especially the maritime life of the Seri Indians; but so far as practicable, advantage was taken of the opportunity for observation in other directions, not only in the Seri country, but throughout Papagueria. Some of the lines of observation may be indicated briefly.

*Tinaja, as used by Spanish Americans, is a natural bowl or bowl-shape cavity, specifically the cavity below a waterfall, especially when partly filled with water; in a more general way it is extended to temporary pools, springs too feeble to form streams, etc. In its specific application it has no equivalent in, and would be a desirable addition to, the English language.

GEOGRAPHY AND GEOLOGY.

The territory traversed by the two expeditions may be conceived as a great plain sloping southwestward from the foothills of the Sierra Madre to the Gulf of California, relieved by occasional rugged mountain ranges generally trending parallel with the high Sierra which divide the plain into a succession of lesser plains or broad valleys; and the great plain must be conceived as undulating somewhat, the chief irregularity being the subcontinental divide coinciding approximately with the international boundary.

The region is extremely arid, the annual rainfall averaging probably less than five inches, and perhaps less than two inches throughout the western half of the area. Streams gather in the mountain gorges, and those heading in the Sierra unite to form a few rivers; but as the waters push out over the plain they are partly evaporated, partly absorbed by the dry earth, so that even the highest freshets never reach the sea; and most of the streams flow only a few miles or at most a few scores of miles, and this only during the rainy seasons or after sporadic storms.

The mountains, especially the minor ranges of the Sierra, are notable for ruggedness and steepness of profile; they are remarkable also in that they usually rise from the plain abruptly or with relatively inconspicuous intermediate slopes—as a clever writer expresses it (picturesquely, but mistakenly, except in appearance) they are 'as men buried to the neck.' The mountain ranges are either naked rocks or steep talus slopes of coarse debris, supporting a scant sub-desert vegetation which increases in abundance toward the summits; the rocks being either metamorphic sedimentaries probably of Mesozoic age, or somewhat younger volcanics, a few nucleal ridges being granitoid. The broad intermontane plains are made up in part of alluvial or torrential debris, fine at the lower levels, coarser toward the bounding foot-hills and ranges, though it is remarkable, and indeed paradoxical, that they consist in large part of the planed edges of hard rock strata such as form the adjacent mountains; the surface of the plain, whether built or carved, being sparsely dotted with trees and shrubs of sub-desert habit. Toward the coast the plains lie but little above and in some cases apparently below sea-level, and are composed of marine sediments, sometimes abundantly charged with recent shells; when the surface is usually a succession of playas and sand dunes.

Seriland is an exceptionally mountainous portion of the great westward-sloping plain, lying near the line along which it dips beneath the waters of the gulf; indeed a part of this staunch little dominion lies beyond the general coast line and is separated from the mainland by a narrow strait, itself the precise homologue of the upland intermontane valleys save that it is occupied by tide water and faintly sculptured by waves and tidal currents. The main insular portion of the territory is Tiburon Island, about 500 square miles in area; the continental portion is some 2500 square miles in area; and a few small islands adjacent to Tiburon and the Sonoran coast belong to the same natural district, and are held by the Seri Indians. Tiburon Island comprises half a dozen ranges, major and minor, the higher peaks rising from 3000 to 4000 feet above tide; in its principal interior valley there is a feeble stream, gathering among the higher peaks and wasting within a few miles, besides some half dozen tinajas and springlets. Sonoran Seriland is also mountainous, the culminating peak rising about 5000 feet above tide, and contains a feeble permanent spring and two or three water holes in which the water is brackish. Of the entire area south of Gila river and west of the Sierra, about four-fifths may be classed as plain, one-fifth as mountains; but in Seriland more than two-fifths and probably three-fifths must be classed as mountains, leaving only a moderate fraction to be classed as plain. This mountainous tract is separated from Papagueria by a broad waterless zone of playas and sand dunes, abounding in partially fossilized shells.

It is to this desert barrier, 20 to 40 miles across, that the isolation, and apparently many of the characteristics, of the Seri Indians are due; for it is a natural boundary, one of the most trenchant and effective on the Continent, practically impassable without special training, and so conditioned as to be easily defended along the inner margin in case of invasion.

When the mountains and intermontane plains of Papagueria and Seriland are examined in detail, certain peculiarities appear: As already observed, the mountains are notable for ruggedness and the plains for flatness nearly or quite to the mountain bases; again, the parallel ranges are found to be occasionally united by cross bars, so that a common form of mountain plan may be likened to the letter H; still further, it is found that the larger arroyas and rivers seldom follow the axes of the valleys, but usually flow athwart them and frequently traverse the bounding ranges in narrow gorges opening toward the gulf, while many southward-flowing streams head on the northern sides of the cross-bar ranges through which they pass in youthful canyons. On assembling these peculiarities, they are found to point toward two successive sets of geologic conditions: The distribution of the minor ranges with their transverse connections, coupled with the fact that a large part of the area of the intermontane plains is planed, indicates that the region was formely a plateau which maintained its altitude and attitude until the feeble sub-desert streams degraded the greater part of the mass, leaving only the harder ledges and broader divides as remnantal ranges; while the incongruity of the modern waterways indicates that, after assuming this general configuration, the tract was tilted southwestward in such manner as to stimulate the streams flowing in this direction and paralyze those flowing northeastward, and thus to produce a general migration of divides. These indications may perhaps be misleading, or may have been misinterpreted; and the abrupt transition from rugged mountain slope to planed base-level is an attendant feature which requires explanation before the interpretation can be regarded as final. The researches relating to this subject are not complete, but both Mr. Willard D. Johnson, of the later expedition, and the writer have collected data bearing on the subject. Among other data may be mentioned an admirable section exposed along the gulf shore from Kino bay to San Miguel point (some 20 miles), in which the relations between rugged range, planed base-level, and torrential plain are clearly shown.

Mr. Johnson carried forward a planetable survey throughout Papagueria and Seriland, which will not only yield the first trustworthy map of the region, but will serve as a basis for the representation and interpretation of the geology.*

METEOROLOGY.

Throughout the expeditions of 1894 and 1895, noninstrumental observations were made on winds, clouds, precipitation, frosts, etc., and noted with considerable care, with the view of determining the influence of these elements of the weather on geologic process, on the flora and fauna, and on the human population, native and introduced. These notes, made incidentally at a constantly shifting base and for short periods only, would be of little value in a region adequately supplied with meteorologic stations, but acquire some value from the dearth of observations in the district to which they pertain, particularly since this district aids in shaping the weather conditions prevailing over a considerable area in southwestern United States. Prof. Cleveland Abbe has signified a desire to publish the notes in an early number of the *Monthly Weather Review* of the United States Weather Bureau, and the material will thus be made accessible to meteorologists. The notes acquire value also from the close relation between weather and life in this region.

It may be observed in brief that the chief weather characteristic of the region is aridity, the rainfall being limited in quantity and irregular in distribution; there are two nominally rainy seasons, in July-August and January-February, respectively, but rains sometimes occur at other times, while precipitation often fails during these seasons; but whether rain falls or not, these are seasons of greater or less humidity of the air, so that the flora is vivified semi-annually, whereby many species are undoubtedly enabled to survive the seasons of drought. The second weather characteristic is heat, especially at lower altitudes; the summers are oppressive for men and animals, the winters no more than pleasantly cool—the weather in Seriland may be inferred from the fact that, while these Indians have words for rain and hail, they have none for ice, snow, or frost. Another characteristic is the dearth of clouds, and the consequent intensity of light and fervidness of insolation by which the skins of men and animals are undoubtedly, and the habits of certain plants apparently, affected. Toward the coast, fogs are not uncommon in the autumn, and are said to occur at other seasons; this weather condition appears to affect the flora for 10 to 50 miles inland, according to the local configuration. The

* A preliminary impression of the Seriland portion of the map will appear in *The National Geographic Magazine* for April, 1896.

relations between weather and the life of the region, human and sub-human, are thus manifold—indeed not only the superficial but the fundamental characteristics of the living things, the very laws of individual and collective development, are largely traceable to weather conditions ; but in a summary statement it is impossible to do more than suggest the bearing of the researches relating to this subject.

ARCHÆOLOGY.

During the earlier expedition it was ascertained that prehistoric works abound throughout much of Papagueria ; during the later journeys the observations on this subject were extended. In almost every valley containing sufficient water to support a population howsoever limited, ruins of ancient villages, remains of irrigation works, etc., are found ; the only exceptional valleys being those in which modern civilization is so extensive as to destroy the more conspicuous traces of earlier culture. Moreover, the prehistoric ruins are in general more extensive than the modern villages, while the ancient irrigation works and fields are carried further up the valley-sides than the modern acequias and farms, indicating that the ancient agriculture was the more extended. The artifacts found in the ancient villages prove that the prehistoric people were potters and that their fictile ware was somewhat finer in quality than that manufactured by the modern Papago ; that they were a peaceful folk, using stone axes, mortars and pestles, hammers, footballs, etc.; that they had temples or other dominant structures more elaborately furnished than their ordinary dwellings ; and there is fairly clear indication that they corralled a small domestic animal, but that they were without larger stock such as was later introduced by the Spaniards. Associated with these ancient relics of well-known kinds there is a distinctive class of ancient works known generally among the Mexicans as 'las trincheras' (entranched mountains), usually found in the immediate vicinity of fertile valleys and especially characteristic of portions of these valleys now, as in prehistoric times, especially adapted to settlement. Commonly the site is a steep-sided butte or isolated mountain several hundred feet high, and the work itself is a rough and rather irregular wall of loose stones circumscribing the butte near its summit ; sometimes the walls are multiplied or built out into bastions, particularly on the gentler slopes, and they may be interrupted where the slopes are precipitous. The walls support either narrow pathways or broad terraces on which house-circles are sometimes found ; and along and within the walls the ground is frequently sprinkled with potsherds and wasters of foreign rock. No granaries or reservoirs have been found within the enclosures, nor is there anything to indicate permanent or long-continued occupancy.

Specially noteworthy examples of this class of works were carefully surveyed during the recent expedition, near San Rafael de Alamito, in Magdalena Valley, 35 miles southeast of Altar; the two principal buttes being known specifically as 'Las Trincheras,' or as 'Trinchera' and 'Trincherita.' The larger butte, nearly a mile long and 650 feet high, is terraced from bottom to top half way round, and on the other side is walled and terraced in part; the smaller is similarly terraced most of the way round. The retaining-walls or revetments are massive and in some cases fully 20 feet in height, and are usually carried from two to five feet above the terrace in the form of breastworks, while free walls of equal height are distributed over the gentler slopes; and fragments of pottery and stone artifacts, as well as spalls and cores of transported rock, besprinkle the ground and might be collected in tons. These works are conspicuous because of magnitude; the prehistoric works of Papagueria in general are noteworthy in extent, and in that they appear to indicate the existence of a more numerous population than that of historic times who stored and controlled storm waters and thus occupied a higher culture-plane than the modern Indian, Mexican and American inhabitants of the same region.

During the recent expedition it was ascertained that, while the prehistoric works of Papagueria stretch to the southwestern boundary of that territory they do not extend into Seriland, where no ancient works were found except shell heaps, cairns, etc., such as the Seri now accumulate. Some of the shell heaps are, however, of great volume and extent, and so situated as to prove that they have survived considerable geographic changes; thus a mound built almost wholly of clam shells (belonging to a series covering several acres) is some 60 feet high and over 300 feet in diameter, and is located on a part of the shore where there are now no clam flats, which the waves have invaded until a considerable part of the mound has been swept away—the section thus exposed revealing typical Seri potsherds and stone hammers from top to bottom. So Seriland appears to be an archæologic as well as an ethnic unit, and there is nothing to indicate that the territory was ever held by other people than the ancestors of the modern tribe.

BIOLOGY.

During the earlier expedition it was observed that the flora and fauna of Papaguara display certain characteristics which were ascribed to the influence of a peculiar environment; and during the later expedition further notes relating to this subject were made, and a small collection of plants was gathered and placed in the hands of Professor J. W. Toumey, of the University of Arizona, for identification and study. While the observations on plants and animals were in a measure casual and were not guided by expert knowledge, they proved particularly suggestive in their bearing on the relations between the human inhabitants of the same region and their environment. These biotic studies indicate that, in sub-desert regions, the development of the individual and the species is determined primarily by a rigorous enviroment; so that the course of development tends at the same time toward pronounced individuality and toward a complex system of coöperation among diverse organisms, whereby each immediately antagonizes, but ultimately serves, its contemporaries. Some of the inferences from the observations of the earlier expedition have already been stated* and need not be repeated; but many new examples, congruous with those previously collected, were noted.

Among the most interesting observations are those pertaining to the coöperative interrelation between animal and vegetal organisms, whereby each depends on the other for existence; this being the stage of vital coöperation called commensality. The best known examples of commensality are those of the fig and fig insect and the yucca and yucca moth, in which the relation was established by Riley; though a still more striking example, in which, however, the relation has not yet been demonstrated, is that of the saguaro, or giant cactus (*Cereus Giganteus*) and its insect mate. During the recent trip two distinct plants were found apparently to represent a still more complex miscigenesis: The cina (*Cereus schotti*), one of the most abundant cacti of southern Papagueria and Seriland, seems not to flower or fruit under what would commonly be considered normal conditions, but only

(* 'The Beginning of Agriculture,' American Anthropologist, Volume VIII., 1895, pp. 350–375.)

after attack and injury by a certain insect (not yet identified). Normally the young cactus sends up half a dozen or more massive stems, usually 5 to 10 feet high and 3 or 4 inches in diameter, beset with thorns along each of the 5, 6, or 7 ribs; subsequently branches spring from these stems, and the plant gradually expands into a clump or colony a dozen feet or yards across. Thus far the plant remains an individual, the product of a single seed; and the period of individual development undoubtedly covers a long term of years, since the younger branches remain vigorous long after the original stems have died and decayed. Now, so far as the observations go, they indicate that the plant does not necessarily or normally fructify during this term of individual development, but that if its insect enemy and mate chances to deposit eggs in the pulp toward the extremity of branch or trunk several changes supervene. In the first place the eggs develop and in due time the larvæ emerge and feed on the pulp; then the branch shrivels, losing a quarter or third of its diameter, and a pilage of slender spines or stiff bristles springs and soon covers the shrunken portion, which may be a foot or more in length; next, under the protection of these spines, a bright-colored flower is put forth, and this in time is followed by the fruit. It is of course to be borne in mind that this sequence has not been studied as a succession of stages in the same plant, but only as an unbroken series of stages exhibited by many plants, so that the sequence may not be regarded as established; but, so far as the observations go, they tend in that direction.

Essentially parallel to the behavior of the cina is that of the dicotyledonous bush called by the Mexicans torotito (not yet identified), the geographic distribution of which is about the same as that of the cina. For a long time this plant was a puzzle because no indication of the mode of reproduction was perceived. It grows in a clump of two or three or a dozen stems springing from a single root, and the colony or clump retains vitality much longer than individual branches, which apparently spring up, attain full growth, die, and decay, while yet the colony survives, so that, as in the case of the cina, the term of individual existence is manifestly long. At length it was noted that the extremities of the separate stems or branches occasionally present an abnormal appearance—tumescent, gnarled and twisted, with leaves or petioles attached; and on dissection it was found that such diseased twigs contain eggs or larvæ. Then, as the season progressed, it was found that the tumescent twigs—and these only—sometimes bear small flowers and, quite rarely, a nutty fruit. So in this case as in that of the cina, the flowering appears to depend on the development of an abnormal condition resulting from ovaposition by an insect (which was not seen in the imago form; but it seems not to be a necessary stage in in the history of any individual, since in many cases the tumescent twig withers and falls off without flowering and of course without fruiting, while only a small proportion of the flowers appear to produce nuts. In this case, too, the observations are suggestive, though not demonstrative, of an ontogenic sequence; yet it is to be observed that the sequence is in precise accord with the biotic relations prevailing in this district, under which the tendency is to perpetuate species by prolonging the life of the individual rather than by multiplying progeny, under which all living things tend to enter a solidarity of remarkable perfection, and under which phylogenic development is either forced and intensified or cut off by the pressure of an adverse inorganic environment. Granting the sequence, or even admitting only the indubitable interrelations found in the region, it follows that the living things of the desert conserve much of the energy commonly expended in reproduction, and thereby approach the plane occupied by the higher animals, with man at their head, among which progeny are reduced in number and improved in the perfection of their adjustment to environment—the plane of solidarity founded on conscious or unconscious altruism, whose occupants, sometimes erroneously classed as sexually degenerate, are the socially regenerate of the earth in that they are fitted to the fulness of life in all its forms.

During the earlier expedition it was found that the plants of Papagueria, "howsoever divergent phylogenically, are notably convergent in a certain group of characters, including leaflessness, waxiness hairiness, thorniness, and greenness";* during the later trip these inferences were verified and corroborated, and it was also observed that still other features are common among genetically diverse plants. Thus, there is a series of trees and woody shrubs, including a half dozen desert forms known as torote, torotito, etc. (not yet identified), which are characterized by swollen trunks and squat forms, in which the woody tissue is pulpy in texture and saturated with watery or slightly viscid sap. When trunk or branch is wounded the sap exudes and quickly heals the wound, either by coating it with lacquer or encrusting it with gum; and when the plant dies the sap escapes and the wood shrinks and gapes widely, even before the bark decays, so that decomposition is rapid and the dead crop quickly makes way for the rising generation. This pulpiness of stem among ligneous plants is like unto the pulpiness of the cactus and agave, which appears to be a device for the storage of water; and while a few of the desert trees (ironwood, catclaw and paloblanca) are characterized by firm woody tissue, most of the arboreal forms consist largely of water-storing tissue, which may be inferred to represent phylogenic adjustment to an arid environment. Commonly these water-filled trees, with certain lesser shrubs abounding in viscid juices and gum, are acrid, astringent or ill-flavored, and some are alleged to be poisonous; others are pungent or noisome in odor (*e. g.* the yellow torote has a penetrating cedar-like odor which is highly offensive to many animals). Associated with these sappy and juicy plants there is a variety of spicy shrubs which in the settled districts are used as condiments and even as substitutes for salt in curing meat. Many of these plants are used medicinally; after describing in detail the virtues of thirty-six medicinal plants, the anonymous author of the 'Rudo Ensayo' (Sonora's classic, written in 1763), adds, "Among the great variety of plants found at every step there is hardly one that has not healing qualities;"* and there is reason to anticipate substantial additions to the pharmacopœa as the flora is studied systematically. Now it is noteworthy that the high-flavored and strong-odored plants are without thorns or other mechanical protective appurtenances; and, in view of all the relations, it seems almost necessary to infer that the flavors and odors are protective and the product of phylogenic development under the local conditions. If this be so, it would appear that the mechanical and chemical devices for individual protection are related reciprocally; and this corollary finds direct support in the characteristics of the cacti, for the juice of the scant-thorned cina is offensive to herbivores, while the well-thorned cholla and nopal are eaten by stock when the thorns are burned off by the vaqueros, and the bisnaga, thorniest of known plants, yields a nearly pure water which has saved the lives of scores of explorers (indeed the work of the last expedition was greatly facilitated by the supplies

* Op. cit., page 362.

* Am. Cath. Hist. Soc., of Philadelphia, Vol. V., 1894, p. 164.

drawn from this natural well of the desert).

Other relations among the plants and between the flora and fauna were noted, but in a summary statement it must suffice to indicate only a few leading lines of observation.

DEMOLOGY.*

In the course of the earlier expedition it was found that if the plants, animals and men of the desert be compared with respect to individual or physiologic (*i. e.*, purely biotic) characters "the stationary plants have suffered greatest modification, the environment-driven animals less, and the environment-molding humans least of all;" but that "when they are compared with respect to collective or demotic modification, it becomes manifest that the moveless plants are least, the moving animals more, and prevising men most profoundly modified."† It was found also that the collective modification tends through coöperation to the development of a solidarity in which the several organisms unconsciously or semi-consciously combine against the rigorous environment. Finally it was found that there are three stages in the coöperation of plants, animals and men, viz.: communality, in which the organisms stand together for mutual protection yet retain undiminished individuality; commensality, in which unlike organisms unite to the end that one or both species may be perpetuated; and agriculture, or the state in which intelligent organisms (especially ants and men) regulate the course of common development by exclusion of the perverse. Thus the earlier researches indicated not only that there is a reciprocal relation between biotic and demotic characters, but that, in a rigorous environment, the latter characters are found among nongregarious animals and plants as well as among men and gregarious animals. The researches also supplemented historical records proving that agriculture began in desert regions by showing the manner in which intelligent organisms are unavoidably forced into this highest grade of coöperation by desert conditions.

*This term is used as a synonym of sociology in its widest sense, but with still wider meaning. It may be defined as the science of organizations, whether spontaneous or purposive, among organisms.

†'The Beginning of Agriculture,' op. cit., p. 374.

During the later expedition the researches concerning collective or demotic relations were continued. The observations among the Papago Indians were extended not simply to the relations between the human group and the sub-human assemblage, but also to the relations among the individuals and sub-groups of the human assemblage. The details noted are many and of a diverse character, and it must suffice at present to indicate their sum. In general, it was found that the continual struggle for existence under adverse conditions has tended to strengthen character among the human units, and to render each individual strong, self-reliant, resourceful, decisive, just as the plants and sub-human animals have been rendered long-lived and vigorous; but that this tendency toward the development of individuality is accompanied by an altruistic tendency under which the human units are brought into sympathy and union of exceptional closeness. In nomadic desert life individuals and small groups are constantly exposed to the risk of death by thirst, and occasion frequently arises for other individuals or sub-groups of the same assemblage or tribe to relieve the sufferers, and if this is done the assemblage is strengthened, while if it is not done the assemblage is weakened. So also isolated individuals are in danger of starvation, of attack by predatory animals, of poisoning by animals and plants, or of death in other ways, in a larger ratio than when several are in company; yet the character of the country is such that hunters, warriors and other travelers must journey far and in limited groups, and hence there is an incentive toward grouping by physical parity which is more or less independent of kinship or biotic affinity. Other tendencies also enter; but individually and conjointly they make for altruism, and eventually for a humanity and charity transcending family ties and gentile bonds. Now the characteristics of the Papago, as recorded by different observers during the last 350 years, comprise dignity and courage, docility and virtue, humanity and intelligence, hospitality and integrity; and these characteristics, which are akin to those of civilization, are among those toward which his hard environment tends. Thus it would appear that these people of the desert have been forced by environment toward civilization; and it would appear also that, just as the plants and animals have been hurried into the higher stages of phylogenic development by physical pressure, the Papago have been forced into civilized relations before acquiring civilized culture. The course of human development may be divided into two great stages characterized by distinctive modes of expression. The first is the prescriptorial stage in which ideas are thrown into crude and incongruous classes for mnemonic purposes; the second is the scriptorial stage in which ideas are expressed by arbitrary symbols, graphic and phonetic; and these stages are none the less veritable because the transition from one to the other has taken place gradually among many peoples; this transition being perhaps the most sweeping and important in the whole course of development of mankind. During the earlier stage, in which incongruous things are connoted, there has been among many peoples, notably the various American families, a custom of connoting kinship with tribal law; indeed tribal law is memorized and perpetuated largely through terms of relative position of individuals in the family, in the clan or gens, and in the tribe; so that among these peoples tribal law tended toward the perpetuation of kinship systems, and remembered kinship crystallized and perpetuated tribal law. Thus the basis of prescriptorial society ever smacked of nepotism and made for egoism rather than altruism. But in Papagueria, where the conditions led to the development of an altruism transcending filial, paternal and fraternal feeling, the consanguineous system seems to have weakened and the system of law bound up therewith seems to have dropped into desuetude, and the people seem to have risen to the moral plane of civilization without making the usually parallel transition from the prescriptorial to the scriptorial stage in the art of expression. It is impracticable now to develop this line of research in detail; it must suffice to note in passing that the observations and inferences indicate that civilization, no less than agriculture, must be reckoned among the products of the desert.

Although in many respects antithetic to the Papago, the Seri Indians are interrelated with their environment in various ways. Seriland proper comprises a large island (Tiburon, about 500 square miles in area) and several islets in the Gulf of California, with a several times larger area on the adjacent mainland; the entire tract is mountainous and exceedingly arid, only one feeble streamlet and a few small springs or tinajas existing within it; and it is clearly set off from contiguous habitable territory by a broad desert zone. From time to time the Seri steal across their bounding desert in predatory forays or for petty trade, and during the early history of western Mexico they established nominally permanent settlements so much as 75 miles beyond their natural boundary; but it has been their custom, always in case of defeat and commonly in the event of ordinarily manful opposition to their predation, to retreat to their stronghold, which they have stoutly defended against invasion. There they subsist on abundant and easily obtained sea food, on the game of the subdesert mountain slopes, and in season on the fruits of cacti and other plants of the foot-hills; and since these sources of subsistence unfailing and easily reached through means shared with feral animals, the Seri tribesmen have ever been notably independent of other peoples and cultures, and this territorial dominion has remained an ethnic unit since the time of Coronado.

The Seri Indians display several more or less distinctive characteristics, both biotic or individual, and demotic or collective. Individually they are of superb physique, able to run down fleet game and capture half-wild Mexican horses without ropes or projectiles; able to run across the sand dunes and playas of their bounding desert, waterless and foodless, so rapidly as to escape pursuing horsemen; able to abstain from food and water for days; able habitually to pass barefoot through cactus thickets and over jagged rock slopes without thought of discomfort; able to gorge carrion and swill the reeking filth of shrunken tinajas without injury; typically they are trained athletes, strengthened against exercise, habituated against abstinence, hardened against pain, and inured against poison, all at the same time and all in remarkable degree. Considered as a demotic unit, the Seri are characterized by hereditary enmity toward alien peoples; for three and a half centuries they have been at war or on the verge of war with Spanish explorers and missionaries, with neighboring tribes, with Mexican pioneers, with American prospectors; they profess a passion for alien blood, always gratified save when they are deterred by fear; they are fiercely endogamous and the blackest crime in their calendar to-day is the infraction of this law; they speak a distinct language, apparently representing a distinct stock; so far as can be ascertained, their mythology is distinct; save for a few simple arts that seem to have been acquired through imitation, their culture is primitive, protolithic as to stone, nascent only as to customary and house-building, unborn as to agriculture, and well advanced only in connection with their reed balsas and the cords of vegetal fibre or human hair used in making them; their grade of coöperation or order of solidarity is below that of the farmer ant, below that of the yucca moth, not even on a par with that of the seed-scattering bird that has aided in giving character to a flora, for (except that they have domesticated dogs) they merely destroy and never propagate or otherwise aid associated organisms; collectively they are bitterly inimical to men, animals and plants, and are parasitic on a peculiarly conditioned tract to which they have adjusted physique and tribal custom. Considered as a group composed of interrelated individuals and subgroups, the characteristics of the Seri Indians include strong family ties, manifested especially in maternal affection and in their little-understood kinship system; firm conjugal bonds (despite modern polygyny due to repeated decimation of the warriors), displayed in their endogamy and in a singular marriage custom; fixed tribal union (despite internal dissension in the intervals of external conflict), revealed in community of property and interests especially in relation to alien peoples; and rigid adherence to custom, as exemplified in the crudeness of their arts, in their habit of locating camps and habitations far from fresh water, in their amor patriæ, and in many other ways, *i. e.*, their intertribal characteristics, like their physical attributes, are strongly individualized and tend toward tribal integrity, independence and isolation. History and archæology indicate that the characteristics of the Seri have persisted long; for three and a half centuries they have been known as fierce and powerful warriors, tumultuous in battle and swift in retreat; reputed as users of poisoned arrows and perpetrators of repulsive atrocities in their endless and relentless warfare; regarded as Ishmaelites harboring in the fastnesses of a desert island (for the insular and continental portions of Seriland have never been clearly discriminated by neighboring peoples), whose bestiality placed them all but beyond the pale of human kind. There are indeed records of attempted conversion and subjugation among the rancherias overflowed from Seriland proper, but the assemblage of records is either contradictory or indicates that the converted and subjugated tribesmen weakened and died under the yoke of a higher culture; an apostate Seri resides in Hermosillo, another in Altar, and a third is said to live in California, but no other trace of Seri flesh or blood was found outside of Seriland. The testimony of ancient works is accordant with that of the writings; outside of Seriland there are prehistoric ruins indicating a succession of more or less distinct populations extending over many centuries; in Seriland there are no works save such as the Seri now produce, though some of these are impressively ancient.

While several of the characteristics of the Seri Indians are unusual and some (*e. g.*, their fleetness and endurance, their unique marriage custom, etc.) so singular as to challenge belief, the assemblage of characters is remarkably consistent and harmonious. The physical perfection of the warriors and their vigorous wives and fleet-footed children is in harmony with their mode of life and militant habit, as with all other characters; indeed they would be unable to survive, to capture strong swift and alert game, to traverse the long waterless stretches in their domain, to cross their bounding desert, without exceptional physique, which may thus be ascribed to survival of the fittest during the generations of development and adjustment to a peculiar environment. Their hereditary blood-thirst is consistent with their enmity toward animal and plant, with their primitive art, with their endogamy, with their linguistic independence, and with their physical characteristics; indeed warfare against other peoples is but an expression of disposition and habit manifested in many other ways. Their rigid endogamy and rigorous marriage custom are consistent with each other, with the long isolation of the tribe attested by history and archæology, with their linguistic distinctness, with their continuous warfare, with their abstemious habits, and with all their other characteristics; indeed their marriage custom would be inexplicable and incredible except in conjunction with their endogamy, while their conjugal relations taken collectively would appear incongruous among a more advanced people. Thus the leading characteristics of the tribe are mutually consistent and interrelated in such manner as to form a definite assemblage, of which no one could be modified without affecting the integrity of the whole. So, too, when the characteristics are considered in sequence or phylogenically, it would appear that each stimulates and combines with all the others in such manner as to render the development cumulative; and also that each feature and the assemblage of features are such as might normally result from the survival of the fittest in a peculiar environment. Finally it would appear that all of the characteristics of the Seri Indians, biotic and demotic alike, are adjusted directly or indirectly to an arid, mountainous land, bordered with a fruitful coast, and protected by a strong natural boundary, *i. e.*, to the actual Seriland, and that they could hardly have been developed under a different environment.

On contrasting the Papago and Seri Indians, it is found that many of their characteristics and their respective courses of development are widely diverse. The former are habitually at peace; the latter habitually at war. The former coöperate with men, animals and plants; the latter antagonize men, slay animals and destroy or neglect plants. The former developed the highest attributes of humanity to the extent that they met the Spaniards as peers; the latter remained robbers and assassins. The former produced arts, rose into agriculture, and at one time made conquest of the waters; the latter are perhaps the most primitive of American peoples. The former tribe is populous and probably increasing in number, despite the invasion of their territory by white men; the latter has been reduced to a handful and is destined to disappear, probably within a decade, almost certainly within a generation, perhaps within a year or two. In a few characteristics the tribes are similar, in certain respects their courses of development have been parallel; but the differences are more striking than the resemblances. Both peoples have been subjected to hard conditions with unlike, but not necessarily incongruous results; as among fishes the darkness of the deep sea may lead either to development or elimination of the eyes, so among men stress of circumstance may lead either to the growth or to the decay of humanity.

In considering the relations between tribes and their environment it is desirable to avoid a common and natural misconception to which attention has been directed by Powell. There is indeed a direct relation between the physical characteristics of the individuals composing the tribe and their environment, in virtue of which the hard environment tends, through survival of the fittest, to produce excellence of physique among men as among the lower animals; but among mankind this direct relation is overshadowed by an indirect relation passing through the institutions, arts, etc., of the human animal. The importance of this indirect relation is indicated by the generalization that the moveless plants are most, the moving animals less, and demotic mankind least affected by environment so far as purely physical or biotic characteristics are concerned, while the converse is true of the demotic characteristics. The same law is well illustrated by the Papago and Seri tribes. The Papago Indians were enabled to survive desert conditions by organization and by an assemblage of arts growing into agriculture; while the Seri, albeit of fine physique, have been enabled to survive only by tribal union, endogamy, a consistent system of warfare, and an assemblage of arts all adjusted to their habitat even more closely than the striking Seri physique is adjusted to desert-bound Seriland.

W J MCGEE.

WASHINGTON, D. C.

NOTE ON THE PERMANENCE OF THE RUTHERFURD PHOTOGRAPHIC MEASURES.

ONE of the most interesting questions confronting practical astronomers at the present day is the question of how long the photographs which are now being accumulated in such great numbers will remain fit for measurement. To throw some light on this matter, I have caused some of Rutherfurd's Pleiades plates to be remeasured with the new Repsold measuring machine of the Columbia College Observatory. The present note is published in advance of the detailed account of the observations and their reduction, as the matter seems to be of immediate interest to astronomers. The measures have been carried out with great care by Mrs. Herman S. Davis and Mrs. Annie Maclear Jacoby. As measures of these same plates were made under Mr. Rutherfurd's direction by Miss Ida C. Martin soon after the plates were taken, in 1872 and 1874, a simple comparison with the new measures out to show whether the plates still admit of accurate measurement, and whether the positions of the star images have changed by an appreciable amount. It is to be noted of course that the Rutherfurd plates were made by means of the wet-plate process, using albumenized plates; so that the results of the present paper are not strictly applicable to the modern gelatine dry-plates. Yet it seems fair to suppose that the gelatine plates will be at least as permanent as those of Rutherfurd. In any case, the present research is of considerable importance because of the large number of Rutherfurd plates not yet measured, and the measurement of which would be useless if their precision has been seriously impaired.

It is therefore a source of congratulation that the new measures here described have not brought to light any such alterations of the photographic film as would invalidate measures made on the Rutherfurd plates twenty years after the date of exposure. In fact, we may say that in no instance does the difference between the new and old measure exceed such an amount as might reasonably be expected from the combined uncertainty of both. For the present purpose, I have not thought it necessary to re-measure all the plates treated in my paper on the *Pleiades* (Annals N. Y. Acad. of Sciences, Vol. 6, p. 239). Nor have all the stars been re-measured, since a few stars well distributed on the plate would undoubtedly bring any existing change to light. On the other hand, every care possible has been taken to make the measures as accurate as possible, except that the insignificant 'projection error' found by Donner to exist in the Repsold apparatus has not been taken into account. Of course this is of no importance in the work under consideration, because the elimination of the errors of projection would be almost certain to improve the average accord with the old measures. The same is true of any errors which may perhaps exist in the guiding cylinder of the Repsold machine, and which have also been neglected.

To avoid any possible bias in selecting plates for remeasurement, I determined to measure those plates to which even numbers had been attached by Rutherfurd at the time the plates were made. But we were unable to find plate number 20 among the plates deposited at Columbia College, so the remeasurement has been applied only to plates 16, 18, 22 and 24. On each of these plates eight stars were selected for remeasurement, distributed on the plate in a way well suited for bringing any disturbance of the images to light. After this work had been finished, it occurred to me that the stars selected were all fairly bright, and that it would be very desirable to measure some faint stars too. Accordingly six faint stars were selected, and were very carefully measured on plate 16. The stars Anon. 34 and 18 *m*. were used as standards on all the plates.

Inasmuch as the Repsold machine furnishes rectangular coördinates, whereas the Rutherfurd measures were in distance and position angle, it was necessary to compute the distances and position angles from the measured rectangular coördinates, before a direct comparison could be made. The following table contains the results of such comparison. In every case the ratio adopted for the quantity:

$$\frac{\text{Rutherfurd scale value}}{\text{New scale value}}$$

was such as would make the sum of the discordances in distance between the new and the old measures zero. Similarly, a constant was applied to the discordances in position angle, so as to make the sum of these discordances zero. The discordances in position angle have been turned into arc of a great circle by multiplying them by the sine of the distance. For this reason the sum of the position angle discordances will differ slightly from zero, as the constant was applied before turning them into arc of a great circle. It should perhaps be remarked that the comparisons were made with the old Rutherfurd measures as printed in my paper on the *Pleiades*, already referred to, without the application of any corrections whatever. In conclusion, I wish to express my thanks to RUTHERFURD STUYVESANT, ESQ., who had placed at the disposal of PROF. J. K. REES, Director of the Columbia College Observatory, funds for the reduction of the RUTHERFURD plates. This has enabled the Observatory to secure the services of MRS. HERMAN S. DAVIS, who has relieved me of the very arduous labor of computation involved in the reduction of these measures.

TABLE OF DISCORDANCES,

RUTHERFURD MEASURES *minus* NEW MEASURES.

Star.	Plate 16.		Plate 18.		Plate 22.		Plate 24.		Means.		MAG.
	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	Angle.	Dist.	
A 34	0.″00	—0.″12	—0.″24	—0.″21	+0.″07	+0.″26	—0.″20	—0.″02	—.″10	—.″02	7.2
18 *m*	— .06	— .06	+ .12	+ .05	— .08	— .34	— .14	— .02	—.04	—.09	6.3
A 12	— .01	— .18	+ .40	+ .14	+ .16	— .10	+ .27	+ .13	+.20	.00	7.5
A 22	— .04	+ .27	— .06	— .08	— .06	+ .19	— .04	+ .06	—.05	+.11	7.0
A 24	— .02	+ .16	.00	+ .30	— .13	+ .10	+ .07	+ .30	—.02	+.22	7.0
A 28	+ .08	— .10	+ .18	— .13	— .12	— .13	— .14	— .43	.00	—.20	7.0
A 30	— .02	— .01	— .45	+ .08	+ .17	— .01	— .17	+ .00	—.12	+.02	8.4
A 39	+ .41	+ .03	+ .14	— .18	+ .39	+ .02	+ .20	— .01	+.28	—.04	7.7
A 34	+0.″14	—0.″15							+.″14	—.″15	7.2
18 *m*	+ .03	— .17							+.03	—.17	6.3
A 5	— .26	+ .06							—.26	+.06	9.1
A 6	— .05	+ .03							—.05	+.03	9.0
A 11	+ .04	+ .06							+.04	+.06	9.1
A 26	+ .19	+ .12							+.19	+.12	9.0
A 27	+ .03	+ .03							+.03	+.03	8.5
A 36	— .26	+ .02							—.26	+.02	8.5

HAROLD JACOBY.

COLUMBIA COLLEGE OBSERVATORY, March 10, 1896.

ANNUAL RECEPTION AND EXHIBITION OF THE NEW YORK ACADEMY OF SCIENCES.

THE New York Academy of Sciences held its third annual reception on the evening of March 16th, at the American Museum of Natural History. The reception included an exhibition of apparatus and specimens illustrating the progress of science during the year, and more particularly the work done by scientific men in and about New York. The exhibition in the afternoon was thrown open to students in the various educational institutions of the city, teachers and other persons interested in science, while the reception in the evening was attended by the members of the Academy and a number of guests. Both occasions were remarkably successful, the exhibits being of the same high character as have been shown at the previous receptions. The exhibition took place on the second floor of the Museum, which was kindly placed at the disposal of the Academy and was under the direction of Prof.

Henry F. Osborn, who was Chairman of the Committee of Arrangements. An innovation was introduced this year in having an address on recent scientific discovery and the large lecture room of the Museum was thronged by people eager to hear Prof. M. I. Pupin, of Columbia University, give an experimental demonstration of Röntgen photography. Prof. J. J. Stevenson, the President, also delivered an address stating the object and aims of the New York Academy of Sciences.

Among the many exhibits there were a number of unusual interest, as an effort had been made to include in the exhibition only objects illustrating recent discoveries or researches.

In the Astronomical section, which was under the direction of Prof. Harold Jacoby, there was exhibited a series of photographs lately made at the Harvard College Observatory. Prof. J. E. Keeler, of the Allegheny Observatory, contributed a series of photographs of planetary spectra. Prof. J. K. Rees exhibited some lantern slides and new instruments from the Columbia University Observatory. Prof. William Hallock, of the section of Physics, had collected in his exhibit a number of instruments and photographs connected with X-ray investigations. Several from Prof. Rood's laboratory showing the reflection of the rays and other phenomena; a series from Prof. Robb, of Trinity College, the most interesting of which was a record of the test of genuine and imitation gems, the real stones in each case appearing translucent; and a set from from Prof. Stevens, of Troy Polytechnic Institute, attracted considerable attention. Prof. Hallock's voice analysis apparatus was also shown and was accompanied by a number of photographs of vocal cords in action and the manometric flames. Prof. Pupin, the Chairman of the section of Electricity, exhibited a complete set of apparatus for producing the Röntgen rays, and by means of an Edison fluoroscope the penetration of the rays was shown. Prof. Pupin exhibited also a number of photographs he had taken and the apparatus he had devised for studying long electric waves. Charles T. Rittenhouse showed apparatus for studying the magnetic lay in closed magnetic circuits.

In the department of Chemistry the preperation of Argon and Helium was shown and the spectra of these two elements could be seen through spectroscopes. Under Photography the development of process work in colors and new apparatus occupied considerable space, while here also were to be found more Röntgen photographs, that of a boot and foot by Nikola Tesla being remarkably distinct. In the section of Geology Prof. Stevenson exhibited some interesting specimens, while Prof. J. F. Kemp showed specimens connected with recent researches by himself and his assistants at Columbia University. In the division devoted to Mineralogy, under the direction of E. O. Hovy, were exhibited some rare specimens contributed by a number of collectors and colleges. The phosphorescence of the diamond was shown by George F. Kunz, by means of a new apparatus. In the department of Physiography the most recent maps and models were exhibited in the charge of Prof. R. E. Dodge. The feature of the Botanical Exhibit was the topographical map of the New York Botanical Garden, which was exhibited for the first time. A number of preparations and studies were also shown, several of which were undertaken in the interest of the Revision Committee of the United States Pharmacopæia. The Torrey Botanical Club exhibited a series of valuable studies. This section was in charge of Prof. H. H. Rusby and Dr. J. K. Small. An interesting exhibit of aquaria was made in the Zoölogical section and preparations from the zoölogical department of Columbia University were shown. A shin and skull of the fish-eating rodent Icthyomys-Stolzmanni from Peru was shown by the department of Mammalogy and Ornithology of the American Museum of Natural History and was said to be the second known specimen. Dr. T. M. Cheeseman, in the department of Bacteriology, showed some preparations from the Bacterial Laboratory of College of Physicians and Surgeons of Columbia, and there was exhibited by Prof. Henry W. Conn, of Wesleyan University, some morphological preparations of Bacillus No. 41, interesting for its power of ripening cream for butter. Prof. George S. Huntington, of the division of Anatomy, had an extensive collection illustrating recent work in human and comparative myology. In the section of Paleontology, in charge of Dr. J. L. Wortman, were exhibited a number of specimens from Wyoming, Utah and Dakota, collected by Messrs. Wortman and Petersen during the past year. The department of Geology of Columbia University exhibited a number of specimens obtained in their last summer's expedition.

In the department of Ethnology and Archæology the recent valuable additions that have been made to the collections of the American Museum of Natural History were exhibited. Prof. J. McK. Cattell, in charge of the Department of Experimental Psychology, exhibited a new apparatus for determining photometric differences by the time of perception. Some new apparatus from the Yale University Psychological Laboratory was exhibited by Dr. E. W. Scripture, while Prof. C. B. Bliss, of New York, showed a pendulum chronoscope.

HERBERT T. WADE.

COLUMBIA UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE INDIAN AS A FARMER.

THE general statement that the Indian of the Eastern United States was when first discovered in the wild or hunting stage of development, must be considerably modified when we come to study his mode of life with care. He was in many parts of the land an agriculturist, a small farmer, and was by no means dependent entirely on wild game or natural products.

This has been forcibly brought out by Mr. Lucien Carr, in an article 'On the food of certain American Indians and their method of preparing it,' published in the Proceedings of the American Antiquarian Society for 1895. The author has examined the literature bearing on the subject thoroughly and his references are abundant and judicious. Within the compass of thirty-eight pages he has collected an amount of information which the student will scarcely find in larger volumes and much of which the archæologist, engaged in the examination of shell heaps and village sites, will do well to make himself acquainted with. His conclusion is that so far as the comforts and conveniences of life are concerned, the Indian was little behind the white pioneer who dispossessed him.

RACIAL PSYCHOLOGY.

IN his 'Anthropologie du Calvados,' recently published at Caen, Dr. R. Collignon calls attention to the statistics of the French population compiled by Jacoby and others, showing the relation of superior mental ability to descent. The method pursued was to make a catalogue for each department of all the distinguished men born in it for a century, without reference to the grounds of their celebrity, and then to note what proportion this bore to a million inhabitants. The differences are remarkable, varying from 690 in the department of the Seine (including Paris) to 13 and 14 to the million in Charente and Creuse. Normandy showed 106 per million.

When the several lines of activity were analyzed in which these became eminent, marked contrasts were observed. The Normans were generally prominent in science, and little so in poetry or works of imagination; while this was reversed for the south of France. Dr. Collignon, therefore, comes to the conclusion: "To the difference of race, a purely anatomical fact shown by the shape of the head and the color of the hair, corresponds a difference in the brain, which reveals itself by a special tendency of the thoughts and particular aptitudes."

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

The annual stated session of the National Academy of Sciences will be held in Washington, D. C., beginning Tuesday, April 21, 1896, at 11 A. M. The place of meeting will be at the National Museum. In accordance with the new rule adopted October 30, 1895, the business meetings of the Academy will continue until one o'clock P. M. The scientific meetings will begin at half-past one P. M.

A bill has been passed by the Legislature of Maryland and signed by the Governor, entitled "An Act to establish a State Geological and Economic Survey and to make provision for the preparation and publication of reports and maps to illustrate the natural resources of the State, together with the necessary investigations preparatory thereto." $10,000 annually is appropriated for carrying out the provisions of the act, and a commission has been established composed of the Governor of the State, the Comptroller, the President of the Johns Hopkins University and the President of the Maryland Agricultural College. At a meeting of the commission, on March 25th, Prof. William Bullock Clark was appointed State Geologist. He will at once begin work in the field.

Brigadier-General Thos. Lincoln Casey died suddenly at Washington on March 26th. He was born on May 10, 1831, and had supervised many important engineering works and public buildings. At the time of his death he had charge of the new Congressional Library, one of the most notable buildings of the world. General Casey was appointed Chief of Engineers in 1888 and was retired in May, 1895. He was a member of the National Academy of Sciences, an officer of the Legion of Honor, of France, and author of many important articles and reports.

The privileges of the laboratories of the International Zoölogical Station at Naples have been extended to *seven* American students for the spring of 1896. At the present moment, however, there are only two American Tables, so that most of these men are accepted at the station through the courtesy of the director, Geheimrath Dohrn. The Smithsonian table has not remained unoccupied a single day since it was established, nearly three years ago, while Prof. Agassiz's table has also been in great demand. This country should have at least three tables at Naples. Who will assume the responsibility of raising the money for the support of a third table?

A marble bust in memory of the philosopher Luigi Ferri was placed, on March 16th, the anniversary of his death, in the hall of the University of Rome, where Ferri taught for twenty-four years. For this memorial about $200 had been collected by subscription.

Frank Weir & Co., New York, announce the publication of an *Index* to the medical press, to be published monthly, beginning the 15th of the present month. It is proposed to give a complete bibliography of papers published in the medical magazines and transactions of the United States and Canada.

Icones Plantarum, which has been edited by Prof. Daniel Oliver since 1891, will hereafter be edited by the director of Kew Gardens.

The French government has decided to continue to Mme. Pasteur the pension of 25,000 fr. which her husband had received for thirteen years.

Prof. Francis R. Fava, who held the chair of civil engineering at the Columbian University, Washington, died at that place on March 26th, aged about thirty-six years.

M. Berthelot, the eminent French chemist, has resigned from the Ministry of Foreign affairs of France.

A RESOLUTION has been adopted by the Senate permitting Prof. Simon Newcomb to accept the decoration of the cross of an officer of the Legion of Honor, and Prof. Asaph Hall that of chevalier, respectively, conferred on them by the French Republic, on the occasion of the centenary establishment of the French Institute, for services to the French Academy of Sciences as corresponding members.

THE Senate Committee on Public Buildings and Grounds has reported favorably the bill providing for the erection of an additional fireproof building for the National Museum.

THE department of geology and geography of Harvard University has placed on exhibition in Cambridge the Gardner collection of photographs, which consists of more than 3,000 mounted photographs and about 1,500 stereopticon views of geological subjects and landscapes, mainly purchased from the income of a fund established in 1892 by George A. Gardner, of Boston.

MR. M. A. LAWSON, government botanist in India and formerly professor at Oxford, died at Madras on February 14th.

MACMILLAN & Co. announce an English translation, by D. E. Jones and G. A. Scholt, of the Miscellaneous Papers of Heinrich Hertz, with an introduction by Prof. Lenard.

Nature states that Mr. Edwin Wheeler has presented to the Natural History Museum a valuable series of water-color drawings of fungi, 2449 in number.

IT is reported in the daily papers that locusts are doing much damage in South Africa. In Natal a 'chief locust officer' has been appointed and $35,000 has been spent in the attempts to check the plague.

THE German naturalist John Gundlach has died in Havana. According to the New York *Sun*, Gundlach was born at Marburg, Hesse-Cassel, in 1810, where his father was a professor in the University. He published in his native country some notable articles on natural history. The wealthy Cuban, Mr. Booth, proposed to him to come to Cuba and write a book on the natural history of the island. Mr. Gundlach accepted, and in 1839 he landed at Havana, and never returned to Europe, except for short visits. In 1844 he began his collection of Cuba's fauna, now preserved at the institute in Havana, and valued at over $200,000. He completed it in 1856. In 1873 and 1875 he went to Puerto Rico, to gather final materials for his book on the fauna of both the Antilles. Mr. Gundlach was also the author of a work on Cuban ornithology.

DR. A. W. BEKETON, professor of botany in the University of St. Petersburg, has retired, owing to ill health.

Nature for March 12th and 19th contains extended and appreciative articles reviewing the recent work of the U. S. Geological Survey.

AT the anniversary meeting of the London Chemical Society, on March 26th, the President, Mr. A. G. Vernon Harcourt, was expected to give the annual Presidential address before the Society.

MR. BERNARD RICHARDSON GREEN, who succeeds General Casey as Superintendent of the construction of the Congressional Library building, has been his chief assistant in all his great engineering enterprises, and was responsible for many of the brilliant and novel devices employed in the critical task of completing the Washington Monument, and replacing its old foundation by a new one. He is a graduate of Harvard University and is Recording Secretary of the Philosophical Society of Washington.

THE nomination of John J. Brice, of California, for Commissioner of Fish and Fisheries was confirmed by the Senate on March 25th.

A RECENT act of the British Parliament provides for the opening of the Government Museums for a portion of each Sunday. It provides that no employee shall be required to be on duty more than six days in the week and that those who have scruples against Sunday service shall be excused from attendance on that day.

MR. HIRAM S. MAXIM has written a series of articles on the evolution and manufacture of Automatic Firing Guns, the first of which appears in the current issue of *Industries and Iron.*

MR. THOMAS A. EDISON has invented an improved form of the fluoroscope proposed by Prof. Salvioni, and at about the same time by Prof. McGee, of Princeton University. In this instrument paper is covered with the fluorescing substance, and the shadows produced by the X-rays may be directly seen. The instrument has the general form of a stereoscope. Mr. Edison uses tungstate of calcium, with which it is said it is possible to see the shadow through three feet of cork.

M. Becquerel has reported to the Paris Academy that he has found that potassium uranyl sulphide when excited to phosphorescence gives rise to rays which last many hours (more than 160) after the phosphorescence ceases, and pass through paper aluminium and copper. They also discharge electrified bodies in a manner similar to the X-rays.

A series of field lessons on 'Birds in the Bush' will be given by Mr. Ralph Hoffmann, of Belmont, Mass., on Saturday mornings of April, May and June, in the neighborhood of Cambridge and Arlington, Mass. The object of the course is to indicate the easiest means of distinguishing the common birds native to this region, and the more interesting of the migrants. The songs of the different species, their favorite haunts, their feeding habits, and the sites chosen for their nests, will be studied. Before each walk, skins of the birds likely to be found will be examined. By beginning about the middle of April students may learn many of our common birds before the rush of migrants in May, and by continuing into June may pursue the study of our native birds after the migrants have passed.

A committee from the New York Chamber of Commerce has been organized to promote the efficiency of the medical library in the New York Academy of Medicine. An attempt is being made to collect $100,000 for the library. The library of the New York Academy of Medicine is one of the most complete in the world and is open, without charge, to all wishing to use it.

MM. A. and L. Lumière have invented an improvement on Edison's kinetoscope, which they call a cinematograph. With this instrument changing scenes are exhibited in their natural size on a screen. The groups, such as a crowd of people passing along the street or a railway train entering and stopping at a station, are said to be very effective. Some nine hundred instantaneous photographs are taken in the course of a minute, and when these photographs are thrown on a screen by means of the electric light at the same rate and order as they were taken an exact reproduction of the moving people is obtained.

The University of the State of New York has recently issued Museum bulletin 14 on the *Geology of Moriah and Westport Townships, Essex County.* Besides describing the general geology of these townships, this contribution to our knowledge of the magnetic iron-ore deposits of the United States discusses in detail the iron-ore bodies of that region, gives the latest information on its important iron-ore deposits and reviews the probable hypotheses as to their origin. It contains a geologic map of the two townships, a map of Mineville iron region, and half-tone views of the mining district and sections of the ore bodies. The bulletin is mailed postpaid to any address by the State Library on receipt of 10 cents. Bulletin 15 on the *Mineral Resources of New York,* by Dr. F. J. H. Merrill, director of the Museum, is nearly ready and will be mailed postpaid for 40 cents.

UNIVERSITY AND EDUCATIONAL NEWS.

GRADUATE SCHOLARSHIPS AND FELLOWSHIPS IN THE UNIVERSITY OF PENNSYLVANIA.

A large number of Graduate Scholarships and Fellowships are about to be established in the University of Pennsylvania. Provost Harrison gave to the University last June, as stated at the time in this journal, the sum of $500,000, to be held as a special fund, and to be known as the 'George L. Harrison Foundation for the Encouragement of Liberal Studies and the Advancement of Knowledge.' The purposes of the fund were described in the deed of gift as follows:

1. The establishment of Scholarships and Fellowships intended solely for men of exceptional ability.

2. The increasing of the Library of the University, particularly by the acquisition of works of permanent use and of lasting reference to and by the scholar.

3. The temporary relief from routine work of professors of ability in order that they may de-

vote themselves to some special and graduate work.

4. The securing men of distinction to lecture, and for a time to reside at the University.

These uses of the fund are not made absolutely binding upon the trustees for all time, but the donor expressed a desire to make the gift as flexible as possible in its application, recognizing the fact "that gifts to universities hemmed in too closely by restrictions are liable to lessen in value as time goes on."

In pursuance, however, of the end in view in the foundation, definite action has been taken in the establishment of a considerable number of Graduate Scholarships and Fellowships. The recommendations which were made regarding these have been approved and will now go into force. There are eight Graduate Scholarships giving free tuition and $100 open to those coming from the liberal courses in the College of the University; and there are, with the Hector Tyndale Fellowship in Physics, now fifteen fellowships, fourteen of which, coming from this Foundation, are open to students of any university. The amount of the tuition deducted from the full value of the Fellowship ($600) does not go into the general funds of the University, but may be used for the purchase of books or apparatus which will aid the student in his work, or may be used in the publication of theses.

A somewhat unusual feature is the establishment of Senior Fellowships, open only to those who have taken the Doctor's degree in the University of Pennsylvania. This amounts to the introduction, in a modified form, of the 'Docent' system of German universities, the object being not at all to use the Senior Fellow as a teacher for the sake of the value he may be to the University, but to test him and give him an opportunity to do a little teaching in the direct line of his special work. From the Senior Fellowships there is no reduction for tuition. This gives eight Graduate Scholarships, fifteen Fellowships and five Senior Fellowships, making twenty Fellowships in all. Fourteen of the Fellowships are open to men from other institutions, but the Senior Fellowships are limited to those having taken the Doctor's degree from the University in order that some of the best men may be kept in residence here as long as possible, and their influence felt among the students.

The whole plan aims at building up a cultured group of men interested in the advancement of knowledge and who shall be in residence at the University. Probably most of them will live in the dormitories, and their influence will undoubtedly be for good in the institution. The whole time of every incumbent of a Fellowship or Scholarship must be given to his scholarly work at the University.

GENERAL.

MR. W. C. McDONALD, a tobacco manufacturer of Montreal, has given $500,000 to McGill University for the purpose of providing a building for the study of chemistry, mining and architecture. This brings his gifts to this university up to $2,000,000.

MR. F. C. MACAULEY, of Philadelphia, has bequeathed to the University of Pennsylvania his library, $5,000 for the purchase of books relating to Dante and Tasso, and $5,000 for archæological researches in America. The bequest to take effect on the death of his brother.

THE name of the University of the City of New York has been changed to New York University by the Board of Regents.

DR. O. CONE has resigned the Presidency of Buchtel College.

PROF. EARL BARNES and Prof. Ewald Flügel, of Stanford University, and Prof. Bernard Moses, of the University of California, are each to deliver a series of fifty lectures at the University of Chicago during the spring term.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

MAJOR POWELL, having escaped (but temporarily, I fear) from the metaphysicians, has courageously entered the camp of the physicists in his paper of March 20th. Now the latter, as a class, are proverbially a simple-minded people, given rather to 'Certitudes' than to 'Illusions' and, as a rule, especially anxious to know what they are talking about, when they talk. They have a distinct fondness for the use of words whose meaning is precise and not open to dispute and, with their brethren the mathematicians, generally prefer to begin a discussion by defining the terms they are about to use, unless such terms are already so restricted and definite in their meaning as to cause no doubt.

Failure to pursue this course is the basis of much idle talk and meaningless controversy, especially at the present time.

People are everywhere talking about an 'honest dollar,' or 'sound money,' without stopping to ask what a dollar *is*, or what is meant by 'money,' or a 'standard of value,' without inquiring what *is* 'a standard and what is meant by value,' and all of this to the confusion of many who would like to give serious thought to important subjects. As Major Powell's philosophy is to furnish a basis for the elementary concepts of physical science, he will not, I am sure, take it amiss if he is asked in the beginning to define with some care the principal terms of which he makes use. No physicist can fail to read his last paper with much interest and, it may be added, with no little astonishment. To one accustomed to the rather simple perspective of the so-called exact sciences, there is a sort of mistiness and obscurity in it which suggests an 'impressionist's' view of the subject.

It is true that in the beginning definitions of 'body,' 'particle,' 'molecule,' 'atom,' etc., are given, which are quite satisfactory as representing the meaning which the author proposes to attach to these words. But the physicists are put entirely out of the controversy by the failure of the author to tell or even hint at what he means by that which is the text of the whole paper, namely, *motion* itself. Major Powell undertakes to show that "motion is persistent," that it "cannot be created or annihilated," and he even goes so far as to declare that this has been demonstrated to the satisfaction of a great body of scientific men. He speaks, often, of 'motion as speed,' thus creating an anxiety to know what 'motion' is when it is not 'speed.' By 'speed' he evidently means 'velocity' as independent of direction, and he declares that 'motion as speed' is 'inherent in matter' and is not imposed upon it from without, from which it necessarily follows that it cannot be transferred from one system to another. Acceleration, he then says, must be considered as 'deflection' or change in that element of motion which is 'direction,' and not in any correct sense a change in velocity. No one will deny a considerable ingenuity in reaching this conclusion, but there are a few obstacles in the way which Major Powell will doubtless easily sweep aside, some of them being suggested in the following questions:

1. What is motion?
2. What is rest?
3. If by 'motion as speed' is meant 'velocity,' and if by its 'persistence' is meant invariability of velocity, what possesses this invariability?—bodies, molecules, particles, atoms?—and *in reference to what* is the velocity constant?
4. As a molecule is considered as a 'body' when reference is had to the atoms which compose it, can it have an 'invariable velocity' as a molecule and variable velocity as a 'body'?

Many other doubts suggest themselves which will probably be quieted by the answers to these questions. I cannot refrain from expressing a hope, however, that in addition to these answers, Major Powell will kindly furnish an explanation of what he means when he says that the transmission of light at the rate of 299,878,000 metres per second furnishes an example of 'particle motion at a velocity so great that any observed molecular motion sinks into insignificance.'

M.

MARCH 23, 1896.

PRINCIPLES OF MARINE ZOÖGEOGRAPHY.

I HAVE been much interested in the admirable review, by Dr. Baur,* of Dr. Ortmann's 'Grundzüge der marinen Tiergeographie,' which I had only previously known from the 'summary' given in 'the Princeton College Bulletin' (VII., pp. 100–107); since then I have had the pleasure of receiving the work itself from the learned author. I find similarity in some features and difference in others between the views of Dr. Ortmann and my own. My contributions to zoögeography appears to have been unknown to Dr. Ortmann, except at second-hand, although exact references were made to publications by Dr. Faxon (p. 233), through

*SCIENCE, N. S., III., 359–367, March 6, 1896.

whom he obtained information.* This is the more regrettable because the similarity between Dr. Ortmann's conclusions and my own is more manifest than that between his and any other investigator's.

The differences between Dr. Ortmann and myself chiefly result from our different modes of approaching the subject. Dr. Ortmann prefers the deductive mode and teaches that "we are to disregard each definite group of animals, and to investigate only the *physical* conditions influencing the distribution."† I prefer the inductive mode and have been influenced mainly by the consideration of the assemblage of the several groups of animals.

Dr. Ortmann, in accordance with his views, recognizes five 'life-districts,' distinguished as follows:‡

"1. Light. The medium is air. Substratum present. Terrestrial district.

"2. Light. The medium is fresh water. Substratum present. Fluvial district.

"3. Light. The medium is salt water. Substratum present. Littoral district.

"4. Light. The medium is salt water. Substratum wanting. Pelagic district.

"5. Dark. The medium is salt water. Substratum present. Abyssal district."

While there is a symmetry in these definitions that may be attractive, analysis will demonstrate that the 'districts' themselves are of very unequal value. In fact, they are framed in contravention of another principle enunciated by Dr. Ortmann: "The topographical continuity of the range is a fundamental principle influencing the dispersal of animals."§

Now, there is no greater interrupter of topographical continuity for land or fresh water animals than wide intervening oceans, and inasmuch as such land areas, with varying limits, have existed for long geological periods, they have been more effective barriers to extension of inland life than the differences connected with the several districts whose 'medium is salt water.' The land and fluvial faunas have consequently been long differentiated and, although in every age there has been doubtless an invasion from the sea into the rivers, the bulk of the fresh water forms in most regions has been long settled and specially developed as such. The districts in question must therefore be segregated under two primary categories, MARINE and INLAND.

But the marine districts still left are likewise of very unequal value. They are distributed by Dr. Ortmann as follows:

"I. Littoral life-district. 1. Arctic region. 2. Indo-Pacific region. 3. West American region. 4. East American region. 5. West African region. 6. Antarctic region."

"II. Pelagic life-district. 1. Arctic region. 2. Indo-Pacific region. 3. Atlantic region. 4. Antarctic region."

"III. Abyssal life-district. No regions distinguishable."

These 'districts' and 'regions' would answer well to divisions which I have established as follows:

I. Arctalian realm (1875) = I, 1.

II. Tropicalian realm = Tropical zone (O.), I, 2+3+4+5.

III. Notalian realm (1875) = I, 6.

IV. Pelagalian realm = II.

V. Bassalian realm = III.

These combinations appear to me to better represent the facts known respecting the distribution of marine vertebrates as well as invertebrates. The first three were distinguished as early as 1875,* but not named till 1877.† Later I deemed it advisable to subdivide the Arctalian into Arctalian (restricted) and Pararctalian and the Notalian into Antarctalian and Notalian (restricted). I also added the Bassalian and still later the Pelagalian. The Pararctalian and Notalian proper have less value than the others, except the Pelagalian, which is the least specialized of all.

I have thus pointed out the chief differences between Dr. Ortmann's views and my own. Naturally, from the difference in our starting points, ensuing differences are great. Dr. Ortmann's method leads to a consideration of 'life

* Grundzüge, p. 59.

† Pr. Coll. Bull., VII., 103.

‡ Pr. Col. Bull., VII., 101.

§ Pr. Col. Bull., VII., 102.

* On the geographical distribution of fishes, *in* An. Mag. Nat. Hist. (4), xv., 251–255, Apr., 1875.

† Wallace's Geographical Distribution of Animals *in* Nation, xxiv., 27, 28, 42, 43, July 12, 19, 1877.

districts' as affected by their animal inhabitants; mine to the aggregations of animals according to their habitats.

The differences are counterbalanced by the resemblances in other respects. Let me close then by endorsing the favorable criticism of Dr. Ortmann's work by Dr. Baur and commending it as well worthy of attention.

THEO. GILL.

RÖNTGEN RAY EXPERIMENTS.

EXPERIMENTS with Röntgen Rays have been carried on very persistently at Case School of Applied Science for several weeks, and some very interesting results have been obtained. The main object has been to secure good photographs of the human skeleton in a living subject, and to increase the practical efficiency of the apparatus. The accompanying photographs of the bones of the hand and forearm, and of an aluminium medal, will indicate the degree of success obtained.

The arm was photographed with an exposure of twenty minutes, while the medal ($\frac{1}{16}$ inch thick) required but five minutes. The Crookes tube used is of the well-known spherical form, having four electrodes, designed to show that the discharge in a high vacuum is independent of the anode, and is one of a set which was exhibited at the World's Fair. It was excited by an induction coil giving about a six-inch spark in air, when using a current of three amperes and twenty volts, obtained from eleven cells of storage battery. The arm was held by bandages to the plateholder, which was supported in an inclined position upon a special stand. The usual plateholder slide of hard pasteboard was between the hand and plate. The tube was placed at a distance of twelve inches above the wrist. Rapid plates were used and developed in the usual way with eikonogen and hydrochinon developer. Slow lantern slide plates give nearly as good results, indicating that the sensitiveness of the plate to ordinary light is no criterion in this work. A great deal of detail appears plainly during development which disappears in the 'fixing' process. Various kinds of developers and fixing agents have been tried to overcome this, without success.

A photograph showing the bones of the fingers has been made with ten seconds' exposure, the tube being two inches above the plate. The bones of the entire arm, including the shoulder joint and of the foot, have been satisfactorily photographed. Attempts have been made to photograph the chest and head with exposures of one hour in each case, the tube being eighteen inches from the plate. The resulting negatives show a surprising amount of detail, which is too faint for satisfactory reproduction. The chest picture shows eight ribs on each side of the spinal column, a dark streak in the latter corresponding to the spinal cord. Under the region of the heart the ribs do not show, indicating that the heart is more opaque than the lung tissue. The collar bone is prominent, while the details of the shoulder joint can be seen. The picture of the head shows the following details: The spinal column in the neck, the jaw bones, with teeth and spaces where several are missing, the nasal cavities, the thickening of the bone showing clearly the outline of the ear, the thin places at the temples, the floor of the brain cavity and the ragged edge where bone and cartilage join in the nose. These pictures, though of little surgical value, are very interesting experimentally. Some of the negatives made clearly show the ligaments connecting the bones at the joints, while none have so far shown any blood vessels or nerves.

Bullets have been located in the hands of four men, and numerous cases of hands injured by machinery and of deformities have been examined, the exposures varying from two to twenty minutes. Some very interesting and valuable pictures of diseased arm bones and of fractures of the arm have been taken. In one case four inches of the arm bone had been removed five years ago, and the extent of the disease is clearly shown. Views of the fractures where the ends of the bones are not in apposition are of value to the surgeons. These photographs are taken through bandages, splints and silicate of sodium casts without hindrance.

A most interesting study has been the position of the various small bones of the wrist in different positions of the hand.

Many interesting points are noted in the work, which are suggestive in a theoretical way, details of which are not ready for publication.

As already announced by Prof. Rowland, it appears that the anode is as important in the matter as the cathode. We have a number of tubes which give results, but none better than the one mentioned, while a tube just received, of American manufacture, promises to equal the imported ones.

The success so far obtained with the arm and chest encourages us to think that still thicker portions of the human body may be studied advantageously, and experiments will be immediately undertaken in this direction.

DAYTON C. MILLER.

CASE SCHOOL OF APPLIED SCIENCE,
March 25, 1896.

[The photographs referred to by Prof. Miller, like all others of a similar character, are difficult of adequate reproduction by photogravure. The bones of the wrist and the large bones of the forearm are splendidly shown and the aluminum medal shows detail nearly as well as an ordinary direct photograph. T. C. M.]

THE INVERTED IMAGE ON THE RETINA.

I CANNOT justly take to myself the severe remarks which Prof. Brooks makes, in the last number of SCIENCE, concerning those who have understood him to mean that there is something peculiarly inconceivable in the *inversion* of the image on the retina; I did not myself take this view, because I happened to know, before writing my letter, that he disavowed this interpretation of his words. I even fail to understand by what rule of logic he drew the conclusion that he was the distinguished scientist to whom I alluded when I used these words: "Prof. Brooks can hardly hope that there should be any consensus among scientific men in regard to * * * * * *consciousness*, if *there are still distinguished scientists* who think that there is anything which needs explanation in the fact that the image on the retina is inverted." (I add the italics now.) This view of the matter is not uncommon, as the following instances, in addition to the discussion which has been going on for more than six months in SCIENCE, and which Prof. Brooks has found so wearisome, will indicate. A physician who had been travelling among the Esquimaux recently reported before a medical society in Philadelphia that those people are in the habit of holding a picture upside down when it is given them to look at; he accounted for this curious fact by supposing that they were in such a low state of development that they had not yet learned to reinvert the image on the retina, and this hypothesis was seriously discussed by this body of physicians, without having its absurdity pointed out by a single member. As another instance, I mention that a prominent Baltimore physician, in writing on the sensations of infants, lately said that they see everything upside down at first, and only learn afterwards to correct this impression.

Since Prof. Brooks has included me among those who have failed to take his meaning as he intended it, he cannot complain if I come to their defence in a single word. He had said: "We all believe many things that are inconceivable, such as the truth that the image in the retina is upside down;" and again, "I illustrated, by the inversion of the retinal image, the fact that evidence may furnish conclusive proof of truths that are inconceivable." Now, while it is true that "if, for purposes of illustration, I declare my conviction that the moon is not made of green cheese," no one has a right to infer that I think the moon is made of cheese of any kind, this supposititious assertion offers no analogy to the case in hand. If a person said that he could not believe that *the cheese of which the moon is made is green*, and also that he was not able to believe in the *greenness of the cheese of which the moon is made*, he would be using expressions precisely analogous to those made use of by Prof. Brooks in the case of the retinal image. Would anyone be expected to use language like this, unless it was the greenness only that troubled him?

C. L. F.

NECESSARY AND SUFFICIENT TESTS OF TRUTH.

EDITOR OF SCIENCE: When Prof. Brooks says that it is a 'great law of logic that the test of truth is evidence and not conceivability,' he uses the phrase 'test of truth' in a loose way which (while it is not uncommon), in the interests of logic, I must protest against.

To the mathematician it has long been a

thing which he has at his finger's end to make the distinction between the *necessary* and the *sufficient* condition for the truth of a statement, and there is no reason why other scientists should not speak with the same precision. One thing is the *necessary* condition for the truth of another, if the latter cannot be true in its absence; it is the sufficient condition, if it must be true in its presence. It may be matter of question whether 'test of truth' should be used in the sense of necessary or of sufficient condition of truth, but it certainly should not be used in both senses in the same sentence. 'Evidence' is the *sufficient* condition for the truth of a statement, but it is not in every instance *necessary.* I need no evidence to convince me that I am conscious. Now those who regard conceivability in the way that Prof. Brooks objects to, do not for a moment consider it to be a *sufficient* condition of the truth of any statement, but they do consider it to be the *necessary* condition of the truth of every statement. The inconceivability of a statement is for them the sufficient test of its falsity, and its conceivability is the necessary test of its truth. Instead of saying, therefore, with Prof. Brooks, that *the test of truth is evidence and not conceivability* (a statement which gives me a slight feeling of dizziness), it would be better to say that *the test of truth is evidence, and inconceivability is no criterion* (or test) *of falsity,* provided the exact terms, necessary and sufficient, should be considered too pedantic.

I have used the terms *necessary* and *sufficient* because they have been consecrated to this purpose by the mathematician, but I believe that *essential* and *sufficient,* or perhaps *requisite* and *sufficient,* would convey the meaning much better for ordinary language. We should then say, *evidence is a sufficient test* and conceivability is not a requisite test of truth.* The sentence "conceivability is not a necessary test of truth" is somewhat ambiguous; it might mean 'is not a test such that the truth necessarily follows from it,' instead of 'is not a test which it is necessary to have fulfilled if the truth is to hold.' But 'requisite test of truth' is not open to any ambiguity.

* That, for nearly all truths, evidence is also a requisite test, is true, but is denied by no one.

I am convinced that if the terms requisite and sufficient (or something equivalent to them) were to come into common use as defining the *kind* of ground, reason, argument, condition or test that the writer has in view, it would conduce very much to facility of comprehension on the part of the reader. M. M.

THE TEMPERATURE OF THE EARTH'S CRUST.

MR. SERENO E. BISHOP, in his letter in SCIENCE, March 13th, remarks that it would be interesting to ascertain what are the rates of increase of temperature now under regions where the subsoil is permanently frozen, as in the tundras of Siberia and Alaska.

Attention may here be called to the Report made to the British Association in 1886, by the committee appointed to organize a systematic investigation of the depth of the permanently frozen soil in the polar regions. Of some twenty-two localities mentioned in that Report, Jakutsk, Siberia, lat. 62°, is perhaps the most noteworthy, the limit of the frozen soil being 620 feet and the temperature rate 1° for 28 feet.

The transcendental formula employed by Lord Kelvin in his well-known chapter on the 'Cooling of the Earth' furnishes results in marked harmony with the temperature rate as determined by many observations. (Prestwich, Proceedings of the Royal Society, 1886.) It does not logically follow, of course, that Lord Kelvin's premises are necessarily correct. However, whether we accept the argument in the 'Cooling of the Earth' or rely on observations alone, we must for the present regard 1° F. per 50 feet (approximately) as expressing the law of the rate of increase of the temperature of the earth's crust near the surface; some local factor should be looked for as the cause of such an exceptionally low rate of increase as that found in the Calumet mine, or such a high rate as that in the Jakutsk mine. In any case it is scarcely safe to assume, as Professor Agassiz seems to do, that the rate observed to the bottom of the Calumet mine holds to the depth of 19 miles and beyond, and thence to conclude that the earth's crust has a thickness of 80 miles. The crust of the Lake Superior region may have counterbalancing abnormal features, so that the low temperature rate for the first mile is amply atoned for before Lord Kelvin's 100,000 feet level is reached.

As regards Mr. Bishop's ice-cap hypothesis, would not an ice cap, on account of the low conductivity of ice, have the effect of raising the temperature rate instead of lowering it?

ELLEN HAYES.

WELLESLEY, MASS., March 18th.

THE PREROGATIVES OF A STATE GEOLOGIST.

EDITOR OF SCIENCE: As is well known to many of the readers of SCIENCE, the writer of this note spent the greater part of five summers in Missouri, studying the crystalline rocks and associated formations over an area about seventy miles square in the vicinity of Pilot Knob, and has published a number of papers concerning them. While Winslow was State Geologist I published the first half of Bulletin 5, and sent in manuscripts to accompany the Iron Mountain sheet, the Mine la Motte sheet, and my final report, which was to constitute a monograph, the last manuscript leaving my hands in August, 1893. The Iron Mountain sheet was engraved and proof sent me for my final revision of the geological boundaries, as was also the proof of my part of the accompanying text, before Winslow left the position of State Geologist, while as early as March, 1892, the Mine la Motte sheet was drawn and I marked the geological boundaries on it, although it has not yet been published.

Shortly after assuming control of the State Survey Office Dr. Keyes wrote me that he would soon take up the manuscript of my final report. On September 23, 1894, he wrote me as follows:

"Since looking over your MS. rather carefully I have come to the conclusion that it would be best perhaps for me to write an introductory chapter on the general geology of the region. We have now so much new material on hand in this direction, and the topographical sheets and reports on this have been completed this summer and are now ready for the printer, so that it would greatly enhance the value of the report to incorporate this work. So much more also is known in regard to the Cambrian since I have made a trip into the region. * * * I will revise the I. and II. chapters, if you are willing, *so as the introductory will not cover the same ground*; so you need not give these chapters much attention." (Italics are mine.)

Knowing the facts regarding the preparation of the sheets as above stated, it is difficult to understand how so much 'new material' could have been gathered in so short a time.

I wrote him in substance in reply to his letter of September 23, 1894, that of course he could write any introductory matter he chose, but that I very much hoped he would not borrow too freely from my manuscript in so doing. On January 29, 1895, he again wrote me:

"Regarding the other part of your letter I can assure you that I do not wish to detract one iota from the work or to deprive you of any credit on account of changes which may be made. Before it is printed I will talk or perhaps 'write' the matter over with you."

The manuscript was finally sent me as Dr. Keyes had revised it, but my first two chapters had been so changed and so many positive errors introduced that I wrote the State Geologist it never would do to have it published in that form. The result was he visited me in April, 1895, and we talked the matters over freely, as I thought. He consented to every change I suggested excepting that he wished my original manuscript abridged more than I desired. During this conversation not a word was said or even intimated that the chapter on the general physiography was not mine. I told him certain of the geological discussions which he had introduced were so different from what I had written that I did not care to be responsible for them. But I never thought of this being his introductory chapter, as he said nothing about it, and as his name was not attached to it, although he called this the first proof. No further word on the subject was sent me, and I was given no chance to further read the proof, although only twelve hours from him by mail. On November 1, 1895, I received the publication which appeared as a part of Volume VIII. of the Missouri Geological Survey. Much to my surprise I found that the whole of the physiographic descriptions and much other matter which I thought was entirely mine appeared under his name without any intimation that I was in any way responsible for it, even though he had previously written, "I do not wish to detract one iota from the work or to deprive you of any credit on account of changes which may be made." He wrote me October 30, 1895, stating that the publication was complete, and saying: "Owing to your objections regarding the introductory section, I thought it best not to impose its authorship on you and consequently I have assumed the responsibility of this section, *as it in no way covers the ground of your first two chapters, except in the case of one or two paragraphs*. You can, of course, publish these elsewhere if you so desire." (Italics are mine.)

Very naturally I felt that this was a bold case of plagiarism, and wrote him on the subject November 14th, in reply to which he wrote me on the 15th: "Altogether there are two and a half or three pages which are taken from you, as I have already stated" (earlier in this letter). How the 'one or two paragraphs of October 30th could grow to 'two and a half or three pages' by November 15th, and this after the publication was complete, is no more mysterious than other incidents which are of no interest to the public. In the same letter of November 15th, he wrote: "More than one-half of that section over which I 'hoisted' my name was written at the request of Mr. Winslow for my chapter on Missouri stratigraphy to accompany the Paleontology report, and this more than three years ago. * * * . At least one-fourth was written for Maryland granites at Baltimore nearly five years ago. * * *. This matter was taken bodily with no changes whatever except several locality names." How this corresponds with his statement of September 23, 1894, regarding 'new material' the reader can judge.

In order to show those interested the relation between my original manuscript and the part with his name to it, the following quotations are made, portions in brackets being my comments.

Extracted from page 84.

GENERAL GEOLOGY OF THE MISSOURI CRYSTALLINE AREA.

(BY CHARLES R. KEYES.)

Geographical Distribution.

The massive crystalline rocks of Missouri are confined to the southeastern part of the State. They occur in irregular masses and isolated hills extending over an area 70 miles square, which is widely known as the Iron Mountain country.

(Then follow ten lines of dissimilar matter.)

Pilot Knob is approximately the center of the crystalline district. For a distance of perhaps a dozen miles in all directions from this point, the massive crystallines form the greater portion of the surface rock; while in an easterly direction they are practically continuous for more than twice as far.

(Which reaches Knob Lick and Fredericktown.)

Beyond the large central field the exposures gradually become less and less frequent. To the north they do not reach much beyond Bismarck. Northeastward they are found in in Ste. Genevieve county, 30 miles from Pilot Knob. On the east, hills of similar rock are abundant as far as Castor Creek. To the south they stretch away in large masses for many miles, with occasional outcrops as far as the boundary line of Butler county. To the southwest, they extend into Shannon county, and perhaps even beyond.

Extracted from Haworth's Manuscript.

GEOGRAPHY OF THE CRYSTALLINE ROCKS.

a. Boundaries.

The crystalline rocks of Missouri are irregularly distributed over an area nearly seventy miles square. The central portion of the area is in the vicinity of Pilot Knob. Here for a distance of from six to ten miles in all directions the Archæan rocks cover the greater portion of the surface, and to the east they are almost continuous for more than twenty miles, reaching as far as Knob Lick and Fredericktown.

Beyond this central area the crystalline exposures continuously become smaller and farther apart. To the north they reach beyond Bismarck, into township 36 N. On the northeast they are found in Ste. Genevieve county nearly thirty miles from Pilot Knob. On the east porphyry and granite hills are abundant as far as range 8 east, or as far as to Castor creek. To the south occasional exposures may be observed as far as township 27 N.

(Which is near the boundary of Butler county.)

To the southwest they extend into Shannon county, and even then it is quite probable the limit is not reached. * * *. To the west the area reaches in almost unbroken outlines to the East Fork of Black River, is quite prevalent to the Middle Fork, and numerous scattered hills have been found beyond; while to the northwest porphyry hills are found as far as Little Pilot Knob, * * in Washington county.

They stretch out to the west almost unbrokenly to the east fork of Black River; while numerous scattered hills continue even beyond the middle fork of the same stream. Toward the northwest similar rocks occur at short intervals as far as Little Pilot Knob, in Washington county.

(Five lines referring the reader to maps.)

The central and most extensive portion of the crystalline is, as just stated, in the vicinity of Pilot Knob and Iron Mountain, and occupies the median parts of townships 33 and 34, north, in ranges III., IV. and V., east of the fifth principal meridian, with occasional extensions much farther in several directions. The crystalline area is almost unbroken for a distance of 30 miles southeast and southwest of Bismarck, which is situated near the northern margin of the great central district. The other masses of similar rock are much smaller and are widely scattered.

(If a knowledge of such boundaries was possessed by anyone other than myself and those who read my manuscript, what a mistake for the State to pay out so many hundred dollars and for me to spend so many months' time in ascertaining them.)

(A little farther along five lines refer the reader to maps.)

First: The central and most solid portions of the Archæan is in townships 33 and 34 N, and in ranges III., IV. and V. E, with occasional projections in different directions reaching much farther.

(About a page and a half of manuscript follows here giving more details of boundaries.)

Page 86.

PHYSIOGRAPHY.

Topography.

(A little less than two pages is of a general character which is relatively distinct from the manuscript).

Page 4.

b. Topography.

(About one page of manuscript is passed here containing many facts mentioned in the printed part.)

Page 87.

The various types of rocks give such characteristic phases of topography to the different parts of the district, that the true lithological nature of the rock composing a hill may be readily inferred at a distance of several miles.

East of the great central mass of crystallines the country is comparatively level, or rather not so rugged as in the immediate vicinity of the porphyry hills. In passing still farther toward the border of the area, the topography continually changes; the porphyry is less frequently found in the valleys, and more and more of the hills is composed of limestone. The granites in various places form high, steep prominences. To the west the difference in the surface relief of the granite areas is even more marked. No less than four of the most conspicuous elevations here are made up of granite. One of these on the East Fork of Black river, in the vicinity of the 'falls' (plate iii.), connects with the long row of porphyry

Page 4.

A little farther to the east, in the big granite area, the country is comparatively level, or at least much less rugged than in the immediate vicinity of the porphyry hills. This is so noticeable that one may well speak of the characteristic topography of the granite areas. The few high hills that occur almost invariably grade into porphyry toward their summits. But as we pass towards the border of our area, in any direction, we find the topography changing. The porphyry is less frequently found in the valleys; an ever increasing proportion of the hills are composed of Cambrian rocks; and, strangest of all, the granites in different places become the constituents of high and steep hills.

(* * * Six lines of manuscript.)

To the west the difference in the topography of the granite is often more marked. No less than four prominent hills here are composed of granite, while the valleys are never covered with it. One of these is on the east bank of East Fork of Black river, in the vicinity of the beautiful and picturesque 'falls' * * *. (Here description is given in detail.)

The granite hill connects with a long row of prominent porphyry hills, but it is higher than any of them. The next most prominent one of the four lies to the north about three miles in the angle between the East Fork and the Imboden Fork. It is locally called 'High Top,' and well it deserves the name, for it stands out prominent above all the hills near it. According to the barometric measurements made by Mr. Kirk it rises 635 feet above the valley at its base, which shows that it compares favorably with Shepherd Mountain, the biggest and highest porphyry hill hills, but is higher than any of them. Another is three miles north of the one last mentioned, between the East Fork and the Imboden. It is called 'High Top,' for it towers above all the hills surrounding it, rising 635 feet above the valleys at its base, and compares in this respect favorably with Shepherd Mountain, the largest and highest porphyry peak of the central area. The third principal granite hill lies to the south, and its height is about the same as the two mentioned; while the fourth is about a mile east of High Top. Farther west are still other crystalline hills, but they are composed of porphyry. Beyond the Imboden fork is another tributary known as Shut-in fork. The word 'shut-in' is a name usually applied throughout the region to every place in which two hills are close together with a stream flowing between. In this case the two hills forming the 'shut-in' are very high, particularly the westernmost, which rises 610 feet above the stream.

Throughout the Black river country there is unusual regularity in the courses of the streams; from which fact it may be inferred that there is a corresponding symmetry in the arrangement of the elevated portions of the region instead of promiscuous scattered positions of the hills so common elsewhere. There is a series of long rows of elevations between the streams. Generally the southernmost point of each is the highest, as in the case of Hightop and the other granite hills mentioned above. From the summit of any prominent elevation in this region there is visible every crystalline mass within a radius of many miles. Here and there may be noticed a prominence standing out more boldly than the others, and they often, after closer inspection, resolve themselves into rude ranges. The most prominent of these groups is in the vicinity of Annapolis. The row forms a broad curve extending to the southwest a distance of three miles. To the east and southeast there are first a few small porphyry hills in the immediate vicinity of the town, and beyond this a large elevation with three prominent spurs. These hills in turn stretch away to the southeast, almost connecting with the row of mountains on the east bank of Crain Pond creek, and from thence to Gray mountain immediately east of Brunot.

Page 89.

Southward from the point of view just mentioned, across a stretch of six or seven miles of lowland, is a second row of hills extending east and west and reaching from Black river to the St. Francois. On the west is Mann and on the southeast Rubel mountain. Both are large porphyry hills. Beyond the latter are McFadden, Aley and Mud Lick mountains, the latter in the central area. A third one of the four granite hills lies on the south line of the same township and will perhaps equal in height either of the two above mentioned, although its altitude has not been measured. The fourth one lies about a mile west of High Top, but is much less prominent.

(Here follows about one-half page giving geologic reasons for peculiar topography.)

West of the Imboden Fork is another tributary known as the Shut-in Fork. The two hills forming the so-called 'Shut-In'—a common term applied to almost every place where two hills are close together with a stream flowing between, are very high, particularly the west one. It rises to a height, according to Mr. Kirk, of 610 feet. * * * *

By consulting a map one will see that in the Black river country the streams come from the northeast and the northwest, converging to a point a little south of Lesterville, in Reynolds county. There is an unusually great regularity here in the direction of the water courses, which means there is a corresponding regularity in the topography of the country, a topography which may almost be named the Black river type. Instead of the irregular, hatchy arrangement of the hills, so common in other places, we find here at least an approach to regularity in the numerous rows of hills between the streams. Generally also, the southernmost point in each row is the highest, as is the case with High Top and the other granite hills mentioned above.

Standing on a prominent hill almost anywhere south of the north line of township 33, particularly in the Black river or the Taum Sauk country, by looking away to the south, one can readily distinguish almost every Archæan hill, each of which is porphyry, lying between the latitudes of Hogan and Piedmont.

('Many miles.')

The country is broken and hilly, but here and there may be noticed a much greater prominence, a hill which stands out so boldly that it at once attracts attention. These large hills, or mountains, as they are locally called, are so independent of each other in location that there seems to be little, if any, relation between them. But when they are platted it can be seen they constitute three distinct groups of hills.

('Rude ranges.')

The northern group is in the vicinity of Annapolis. The row of hills form a curve convex northward, with Annapolis just south of the curve. To the southwest the curve extends about three miles, including as many hills. To the east and southeast one passes a few small porphyry hills, immediately at the town, then Grassy mountain, a prominent porphyry hill * * *.

two rising 710 and 793 feet above the surrounding valleys. The last one is the larger of the two and consists of two separate peaks. The eastern base is washed by the St. Francois river.

Still farther to the southward from the point of vantage named are other hills which appear as an irregular row trending east and west. The westernmost is Finley mountain, a large peak covering nearly six square miles and reaching from the Iron Mountain Railroad on the east almost to Black river on the west. It rises 725 feet above the valley, and may be regarded as one of the largest prominences of the region. To the east is Clark mountain, the highest and the grandest hill in the whole area. It is conical in form and rises majestically to a height of 843 feet above its base. It may be seen from every prominent peak south of Iron mountain, and appears to rise so high above the surrounding hills that it almost seems higher than any of those to the north. Looking in that direction from Clark mountain, the whole country for a distance of thirty miles is visible, from Black river to Knob Lick. The interval between the two points rises as a wall upon the landscape. High Top and Shut-in mountains appear to the northwest, Shepherd mountain to the north, Black and Blue mountains to the northeast, with numberless intervening hills of almost equal height and nearly equal prominence.

One more district deserves special mention in this connection. It is along the St. Francois river below the Silver mines. The hills close in on each side, but usually allowing a valley wide enough to contain extensive farms, first on one side of the stream and then on the other, while at other places it narrows to a width scarcely sufficient to admit the passage of the river. The hills are very large. On the west bank are Black, King, Gray and Mud Lick mountains, with less prominent ones between. On the east bank are peaks which rise fully as high.

Page 90.

c. Drainage.

(Here follows ten lines quite dissimilar from anything in the manuscript.)

(Exact location given.)

Beyond this there is the large hill with its three southern projections

('Prominent spurs.')

* * *. This hill in turn stretches away to the southeast, almost connecting with a row of similar hills on the east bank of Crain Pond creek, and from thence to Gray's mountain, immediately east of Brunot.

Page 8.

If from the point of view before mentioned, or better, from a prominent point in the row of hills just located, one continues looking southward across a piece of relatively low land occupied by many hatchy chert hills, six miles or more away, one will see a second row of hills trending east and west and reaching from near Black River to the St. Francois. Beginning on the west we find Mann mountain *.

(Exact location given.)

To the southeast in Section 11 is Rubel Mountain, another large porphyry hill. Passing eastward still * * * McFadden's mountain is met with, and beyond it to the southeast Aley mountain and Mud Lick mountain, two large and high porphyry hills which measure respectively 710 and 793 feet above the surrounding valleys. Mud Lick mountain is the larger of the two and consists of two separate peaks.

(Three lines omitted.)

It's eastern base is washed by the St. Francois river.

Looking still farther southward other hills can be seen which, with a little imagination, will appear in an irregular row trending east and west. The westernmost one is Finley mountain, a magnificent hill covering nearly six square miles and reaching from the Iron mountain Railway on the east almost to Black River on the west. It rises 725 feet above the valley, and when compared with the hills in the Pilot Knob region, is one of the largest. Passing eastward from Finley mountain and disregarding the smaller hills, one reaches Clark mountain, the highest and grandest hill in the whole Archæan area. It is circular in form, and * * *. (Exact location given.) Its summit rises in magnificent grandeur to a height of 843 feet above the valley. It can be seen from every prominent peak south of Iron Mountain, and seems to rise so high above the surrounding hills that one thinks surely it is higher than any of those to the north. But, in turn, when standing on the summit of Clark mountain and looking to the north the whole country thirty miles away, from Black river to Knob Lick, seems to rise like a wall, or mountain chain, it is so much higher than the intervening hills. From here one can see High Top and Shut-in mountain to the northwest, Shepherd mountain to the north, and Black mountain, Blue mountain and Knob Lick mountain to the northeast, with so many intervening hills of almost equal height that the prominent ones mentioned can scarcely be distinguished.

(Here follow eleven manuscript lines descriptive of topography south of Clark mountain.)

One more region should be especially mentioned in this connection, that along the St. Francois river below the Silver Mines. The granite area above described reaches down the river a mile below the old mining place bearing this attractive name. Here the hills close in on each side forming a narrow valley through which the river flows. In places the valley is wide enough to contain extensive farms, first on one side of the stream and then on the other, while in other places it decreases to width barely sufficient to admit the passage of the river. The hills are very large. On the west bank there is Black mountain, four miles long, King mountain, Gray's mountain, and Mud Lick mountain, with less noted ones between. On the east bank we have hills almost as extensive whose peaks rise fully as high, but which are not so long, nor so prominent by virtue of their names. The highest of these hills have not been measured, but certainly some of them surpass 700 feet, for two or three will almost equal Mud Lick mountain, which is 793 feet above the valley.

(Here follows a page more on topography.)

Many other instances might be given, particularly in the article on weathering of granite rocks, the fissures in the rocks, etc. Every instance mentioned on page 95, such as that of the St. Francois river, was taken direct from the manuscript without any intimation of its source. The figures illustrating Keyes' chapter were principally taken from photographs which constituted a part of my manuscript as it was sent to Jefferson City in August, 1893. Plates III., VI., VII. and XI. are reproduced photographs taken by myself and Winslow of places I specially chose. Plate IV. was taken by Mr. Ladd years ago at my request, while plate X. was called for by my manuscript, although I did not have a copy of the photograph to send with the manuscript.

In his letter of November 15, in referring to my intimation that he had plagiarized he said: "To say that it is, is most emphatically false, to the very last letter." The reader who has sufficient interest to compare the parallel columns above may judge for himself. No one doubts a State Geologist's privilege of writing as many 'introductions' as he may wish, but others also have the prerogative of questioning the utility of such 'introductions' when the State Geologist is compelled to go to a suppressed manuscript to find something to say.

Dr. Keyes seems to be an adept in borrowing illustrations without proper acknowledgment. In Volume I., Iowa Geological Survey, plate IX. was made from a photograph taken by Prof. C. H. Gordon. He subsequently published it in Volume II. as plate IV., and in his report on paleontology for Missouri in Volume IV., plate IX., all without any acknowledgments, although Prof. Gordon had called his attention to the matter (A. J. Sci. (3), Vol. XLVI., p. 398, 1893). In Vol. 2, Proceedings

Iowa Academy of Science, he published plates III. and IV., without acknowledgments, which were first published by Winslow in the text of the Iron Mountain sheet as plates III. and II. For his introduction to my report from the same place he borrowed plates I. and III., using them as plates II., VIII. and IX., respectively, again without acknowledgments. And yet on November 14 he wrote me: "I have only the simple statement to make that no one holds in higher reverence the giving of all due credit to whom it belongs and no one has tried harder than I to give it on all and every occasion."

ERASMUS HAWORTH.

SCIENTIFIC LITERATURE.

A Review of the Weasels of Eastern North America. By OUTRAM BANGS, Proc. Biol. Soc. of Washington, X., pp. 1–24, pls. I.–III., Feb. 25, 1896.

In clearing up the status of the Weasels of eastern North America, Mr. Bangs has done a piece of work that will be welcomed by all mammalogists. He has had access to practically all the material thus far accumulated by American naturalists on the species treated; his results leave little to be desired.

All three of the species named by Bonaparte in 1838—*richardsoni*, *cicognani* and *longicauda*—are found to be valid, and their geographic ranges are for the first time defined. The weasel which heretofore has been persistently confounded with the European *Putorius erminea* is found to be a very distinct species for which the name *P. noveboracensis* of Dekay and Emmons becomes available. This animal is the common large weasel of the Eastern States, where it ranges from the mountains of North Carolina northward to northern New York and central Maine. It is not known from any point west of Illinois.

The small weasel of the Northern States, which it has been customary to call *P. vulgaris*, is the *P. cicognani* of Bonaparte, as recognized by Baird and Mearns, but overlooked by most mammalogists. *P. cicognani* is a northern animal ranging from New York and New England northward, and extending westward all the way to Alaska. Mr. Bangs believes that it intergrades, in the far North, with the arctic *P. richardsoni*, the type of which came from Great Bear Lake. *P. richardsoni* ranges from Hudson Bay to the coast of Alaska.

The weasel of the northern plains, *P. longicauda* Bonaparte, becomes considerably darker along the edge of the forest belt in Minnesota, and the dark form is named as a subspecies, *spadix*.

But the most interesting novelty is a tiny species from the plains of the Saskatchewan, which Mr. Bangs names *P. rixosus*. It is not only the smallest of the weasels, but it is believed to be the smallest known Carnivorous mammal. It has a very short tail, which lacks the black tip of all other species, and in winter the little animal turns white all over. It ranges from Hudson Bay to the coast of Alaska and is exceedingly rare in collections.

The rarest weasel of all is the Florida species, *P. peninsulæ*, recently described by S. N. Rhoads. Only half a dozen specimens, mostly poor, have as yet found their way into collections.

Mr. Bangs' paper is an excellent example of the kind of work American mammalogists have been doing for the past few years. It is based on a sufficient number of specimens to admit of final conclusions, and the specimens have been studied so thoroughly that no other conclusions are likely to be suggested in future.

The paper is illustrated by 3 excellent plates of skulls, all drawn by Dr. James C. McConnell.

C. H. M.

Report on Field-work in Chenango County [New York]. By J. M. CLARKE. (In Thirteenth An. Rept. State Geologist [N. Y.] for the year 1893, Vol. I., Geology. Pp. 529–557, 1 plate, 10 figures.)

Volume I. of the last annual report of the State Geologist of New York forms a book of nearly 600 pages which is devoted to a description of the geology of certain portions of the state and is profusely illustrated with maps, sections, figures and plates. The greater number of separate papers composing the report are not only filled with interesting facts, but also increase our knowledge of the geology of the State to a considerable extent.

On many accounts the report of Dr. Clarke describing the geologic structure of a portion of Chenango county is one of the most important of these contributions, since it considers the correlation of the rocks for a part of the State concerning which great uncertainty and difference of opinion have prevailed. The plate at the beginning of the article gives a clear idea of the character of the sandstones and shales at the base of Vanuxem's Oneonta sandstone, while the figures bring out nicely the lithologic and stratigraphic features of the various sections, which are carefully described by the author and are accompanied by accurate lists of the species of fossils found in the various beds. In the lower exposures, near Norwich, Dr. Clarke found abundant Hamilton fossils; above these Hamilton species also, but with them specimens of *Spirifer mesastrialis, Actinopteria zeta* and a few other species which occur in the 'Ithaca group,' while in the upper part of the shales and sandstones, below the Oneonta sandstone, fossils are very scarce.

The formations of the Middle and Upper Hamilton of central and western New York are usually given in ascending order as the Marcellus shale, Hamilton sandstone with the Tully limestone at the top, Genesee shale, Portage formation (which in central and eastern New York is partly replaced by the 'Ithaca group' and Oneonta sandstone), and Chemung formation. These formations form the Hamilton and Chemung series, the line of separation usually being drawn at the top of the Genesee, although some authors prefer to place it at the base of the Tully limestone.

The Genesee shales and Tully limestone form a marked horizon across western New York, but they disappear in going eastward and are not clearly known east of the Chenango valley. In this eastern area Hamilton fossils, with the addition of a few species found in the 'Ithaca group,' occur in the bluish shales and sandstones underlying the Oneonta sandstones, and whether these deposits belong in the Hamilton formation, or are above the horizon of the Genesee shale and Tully limestone, has been a greatly disputed question.

Dr. Clarke found in the western part of Chenango county that the Hamilton fauna with *Spirifer mesastrialis*, 'and of quite the same character as that of the lower beds at Norwich,' is clearly and unmistakably above the Genesee shales. Consequently it will be readily seen that this work is of great value in accurately determining the line of separation between the Hamilton and Chemung series in central New York. In passing it may be stated that this conclusion agrees with the writer's interpretation of the section near Smyrna, twelve miles north of Norwich, which is at the most eastern unquestioned exposure of Tully and Genesee.

The final settlement of difficult questions of this nature in correlation—and there are many in the United States—will be obtained by careful field study of a typical region by a geologist familiar with its paleontology and also versed in stratigraphical geology.

A preliminary copy of the Geologic Map of New York is now passing through the press, and the above and later work of Dr. Clarke, as well as that of other assistants, will be of great value in revising this map upon which the veteran State Geologist, Prof. James Hall, has been actively engaged for so many years.

C. S. Prosser.

Computation Rules and Logarithms. S. W. Holman. Macmillan & Co., New York. $1.00.

Prof. Holman's book is the outgrowth of several years' experience with large classes and is sufficient for most of the computations occurring in engineering, physics and chemistry. The tabular matter consists of a variety of five and four-place tables, together with modern values of important constants. The introduction, which comprises one-third of the book, is of great value, its chief object being to teach students how to get results of any desired degree of accuracy without wasting time and labor in the manipulation of useless figures. For instance, the H. P. which can be transmitted safely by a certain wrought-iron shaft is $2\pi^2 \cdot 1.364^3 \cdot 10000 \cdot 300/6336000$. How many places of logarithms are to be employed, if the computation-error is not to exceed one per cent.? By one of the author's rules it is instantly decided that four-place logarithms will give ample accuracy. One of the devices on which stress is laid is moving the decimal point till it stands directly after the first significant figure. Thus $850.72 = 8.5072 \cdot 10^2$; $0.000652 = 6.52 \cdot 10^{-4}$.

We cannot go into details, but may say that Prof. Holman's rules are few and simple, and so abundantly illustrated that students will find little difficulty in applying them. The book is probably the best, in its particular field, which is available for American students and engineers. When five-place tables are not sufficiently accurate the author recommends the well-known Vega or other seven-place tables. It is a pity that engineers and others seem to be unaware that Bremiker's six-place tables, revised by Albrecht, are sufficiently accurate for almost any problem which occurs in practice, and are easier to use than any seven-place tables.

A few peculiarities of Prof. Holman's book deserve notice. Negative characteristics are used, even in the tables, and recommended. Decimal points are introduced in the arguments of the tables of logarithms of natural numbers; instead of 621, 6.21 is printed. Interpolation tables are not given for all the tabular differences on a given page, when the differences are large, even though there is ample room on the margin of the page. The interpolation tables given are not accurate. Thus $0.3 \cdot 22$ is called 7 instead of 6.6; this suffices in multiplying by one figure, but in division needless inaccuracy may arise.

In the table of 5-place logarithmic trigonometric functions the argument is for each minute, but no proportional parts are given. There is no provision for finding accurately the logarithmic sines and tangents of small angles involving fractional parts of a minute.

A student will sometimes wish that the author had been a little more particular in his statements. On page xii., for example, after stating two fundamental propositions, "which one can easily verify by algebra or by numerical examples," the author adds:

"A more general form of statement from which these follow is: If several numbers are multiplied or divided, a given percentage error in any one of them will produce the same percentage error in the result." Take the example $\frac{120}{2} = 60$. The student will think that the author means that if the divisor 2 be in error by 25% of itself, the quotient is in error by 25% of itself. This he will find to be false. Had the author given a definition of 'percentage error,' the student would be able to determine whether the above statement were exact, or simply approximately true for such examples as are likely to occur in practice. The two propositions mentioned above might be improved by re-writing.

Two errata have been noticed: In the first line of p. xxiii for 'numerator' read 'denominator;' in the last line of p. xii for 'merely' read 'nearly.'

The book is elegantly printed on heavy paper; one can only wish that it were so bound that it would lie open with a flat page, a *sine qua non* of logarithmetic tables.

HERBERT A. HOWE.
UNIVERSITY OF DENVER.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE subject of the Röntgen rays is discussed in the *March number* by A. A. Michelson, who proposes a new hypothesis to account for the phenomena observed. He mentions, first, the two theories that have hitherto been suggested, that of longitudinal waves and that of projected particles, and remarks upon the special difficulties which each of these theories meets. His own hypothesis he calls the 'Ether-Vortex' theory, which he states as follows:

"Let it be supposed that the X-rays are vortices of an intermolecular medium (provisionally, the ether). These vortices are produced at the surface of the cathode by the negative charge, which forces them out from among the molecules of the cathode." He shows that certain of the phenomena which are most typical and difficult to explain may be accounted for on this supposition. The fact that a high vacuum is essential within the tube while, once outside, the rays can pass not only through air, but also through many solids, is regarded as finding a solution if it be considered that, in order that ether vortices may result from the electrical impulse, this impulse must be communicated to them, and must not be dissipated in the interchange of molecular charges which accompanies, or rather produces, the discharge at moderate or high pressures. At the high exhaustion the energy of the discharge would be largely confined to the ether vortices. The absence of the ordinary light phenomena of reflection, etc., would follow from the nature of vortices.

The first article of the number is by C. E. Beecher, on the 'Morphology of Triarthrus.' This is a continuation and an extension of earlier articles by the same author upon the structure of Trilobites. The results given are presented on a plate showing the dorsal and ventral views of the species, *Triarthrus Becki.* These have been made from drawings based, the first upon three specimens, and the second upon two, all in a very exceptional state of preservation. The perfection with which the appendages of the trilobite are preserved and the life-like position in which they are shown is most remarkable. The author is enabled to draw from them definite conclusions in regard to the relations and functions of these organs of which so little has been known hitherto.

A. E. Ortmann discusses the subject of the existence of climatic zones in Jurassic times, with special reference to the arguments for them given by Neumayr. He contends strongly against Neumayr's views and states his conclusion finally that the differences observed in the faunas of the Jurassic deposits are not caused by climatic differences. J. E. Wolff describes an occurrence of the rare rock, theralite, from Costa Rica, from specimens collected by Prof. R. T. Hill. The rock bears a close similarity to the original type from Montana. The possible existence of a zone of alkaline rocks continuing from the northwestern United States on the east border of the Rocky Mountains is suggested. C. H. Smyth, Jr., describes in detail an occurrence of gabbro and associated gneiss near Russell, St. Lawrence county, N. Y. The gneiss is regarded as derived by the metamorphism of the gabbro resulting finally in entire re-crystallization and the removal of all cataclastic structure. Another extended petrological paper is by W. H. Weed and L. V. Pirsson, forming the first part of a memoir upon the Bearpaw Mountains, in Montana. This is a region which has been hitherto but little investigated geologically. After a brief statement of the general geology, the relation of the sedimentary rocks, largely Cretaceous, to the massive, igneous rocks and tuffs, the authors go on to describe more particularly the igneous rocks, including both the effusive and intrusive forms. The former are most abundant, forming the highest peaks and many of the lesser summits of the region; they are the usual rocks of the foot hills, embracing dark-colored basaltic tuffs, breccias and lava flows, which are parts of the former volcanic cones. They consist largely of lencite basalts. The intrusive rocks described include various forms of trachyte and quartz-syenite porphyry; also associated with the syenite, the rock shonkinite, a type described by the same authors from Yogo Peak, Montana. H. B. Bashore gives some notes on glacial gravel in the lower Susquehanna. Robert Chalmers describes the Pleistocene marine shorelines on the south side of the St. Lawrence Valley, connecting them with the terraces noted farther west along Lake Ontario. The occurrence of free gold scattered in scales through the quartz and feldspar of a granite-like rock from Sonora, Mexico, is described by G. P. Merrill. He shows that the gold cannot be regarded as of secondary origin, assuming that the rock is a normal granite, the occurrence is novel and of decided importance. The number concludes with a series of abstracts, book notices, etc.

AMERICAN CHEMICAL JOURNAL, MARCH.

The Molecular Weight of Sulphur. By W. R. ORNDORFF and G. L. TERRASSE.

In the course of an investigation on the molecular weight of monoclinic sulphur some remarkable results were obtained. Although both the boiling-point and freezing-point methods were used, the results from the latter were not concordant and no conclusions can be drawn from them. The results obtained by the other method are as follows:

1. The molecular weight of sulphur in liquids whose boiling-points are below the melting-point of sulphur, as for example, benzene and toluene, is represented by S_9.

2. In liquids boiling above the melting point of sulphur, the molecular formula is S_8.

3. In sulphur chloride the sulphur is apparently dissociated to the same extent as in the vapor at high temperatures, the molecular complexity being represented by S_2.

On the Determination of Sulphur in Illuminating Gas and in Coal. By CHARLES F. MABERY. The author uses a modification of Sauer's method, burning the gas in a tube in a stream of air, the products formed being absorbed in a standard alkaline solution. The coal is burned in the same way, being introduced into the tube in a platinum boat. The amount of sulphur left in the ash is less than 0.05 per cent. on an average.

Chemistry of the Berea Grit Petroleum. By CHARLES F. MABERY and O. C. DUNN.

A brief account is given of the most important wells and their output, and the character and properties of the petroleum from the Berea Grit.

A Method for the Standardization of Potassium Permanganate and Sulphuric acid. By H. N. MORSE and A. D. CHAMBERS.

If a known quantity of standard sulphuric acid is treated with hydrogen peroxide and potassium permanganate added as long as the color disappears, and more hydrogen peroxide and permanganate added until most of the acid has been used up, and the excess determined by titration with the standard ammonia solution, the strength of the permanganate can be easily calculated.

Some derivatives of unsymmetrical Tribrombenzol. By C. LORING JACKSON and F. B. GALLIVAN. The authors find that two of the bromine atoms in tribromdinitrobenzol are easily replaced by treating with aniline or sodic ethylate. A number of derivatives are described.

Besides a review of recent work on Helium, and notes on the composition of Barium Picrate, and the proposed changes in the *Berichte* and '*Beilstein*,' this number contains reviews of the following books:

'Kurzes Handbuch der Kohlenhydrate,' Dr. B. Tollens; 'Die Chemie der Zuckerarten,' Dr. E. O. von Lippmann; 'Ostwald's Klassiker, Zur Entdeckung des Elektromagnetismus,' and 'Die Anfänge des natürlichen Systemes der chemischen Elemente;' 'Die Lehre von der Elektrizität,' G. Wiedemann; 'Physikalisch-chemische Propædeutik,' H. Griesbach; 'A Laboratory Manual of Organic Chemistry,' Dr. Lassar-Cohn; 'Jahrbuch der Elektrochemie;' 'Anleitung zur Molekular-gewichtsbestimmung nach der *Beckmannschen* Gefrier- und Siedepunkts-Methode,' Dr. G. Fuchs; 'Einführung in die mathematische Behandlung der Naturwissenschaften,' W. Nernst; 'Elements of Modern Chemistry,' C. A. Wurtz.

J. ELLIOTT GILPIN.

PSYCHE, APRIL.

S. H. SCUDDER gives a table to separate the 13 New England species of Melanopli, 10 of them belonging to the genus Melanoplus; H. F. Wickham continues former studies on myrmecophilous Coleoptera; and a notice is added of Plateau's recent experiments on insect vision. A Supplement contains the conclusion of C. F. Baker's account of some new New Mexican Homoptera and the beginning of descriptions of new species of bees of the genus Prosopis (or Prosapis, as the author prefers), by T. D. A. Cockerell.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Biological Section, on March 9th, 1896, Mr. F. B. Sumner read a paper on 'The Descent Tree of the Variations of a Land Snail from the Philippines,' illustrated by a lantern slide. Mr. Sumner described the range in variation in size and markings in the shell, and arranged the varieties in the form of a tree of three branches diverging from the most genealized type. It was shown that these several varieties occupy the same geographical region, and Mr. Sumner was of the opinion that their occurrence could not be explained by natural selection since if the colorations were supposed to be protective it would be impossible to explain the evolution of these three types. Prof. Osborn, in discussion, was inclined to take the same view. Dr. Dyar, however, thought the explanation by natural selection not necessarily excluded, since the variations seemed analogous to the dimorphism in sphinx larvæ, which has been shown by Poulton to be probably due to this factor.

The other paper was by Dr. Arnold Graf on 'The Problem of the Transmission of Acquired Characters.'

Dr. Graf discussed the views of the modern schools of evolutionists and adopted the view that the transmission of acquired characters must be admitted to occur. He cited several examples which seemed to support this view, and especially discussed the sucker in leeches as an adaptation to parasitism and the evolution of the chambered shell in a series of fossil Cephalopods.

Professor Osborn remarked in criticism of Dr. Graaf's paper that this statement does not appear to recognize the distinction between *ontogenic* and *phylogenic* variation, or that the adult form of any organism is an exponent of the stirp, or constitution. If the environment is normal the adult would be normal, but if the environment (which includes all the atmospheric, chemical, nutritive, motor and psychical circumstances under which the animal is reared) were to change, the adult would change correspondingly; and these changes would be so profound that in many cases it would appear as if the constitution or stirp had also changed. Illustrations might be given of changes of the most profound character induced by changes in either of the above factors of the environment, and in the case of the motor factor or animal motion the habits of the animal might, in the course of a life time, profoundly modify its structure. For example, if the human infant were brought up in the branches of a tree as an arboreal type instead of as a terrestrial, bi-pedal type, there is little doubt that some of the well-known early adaptations to arboreal habit (such as the turning in of the soles of feet and the grasping of the hands) might be retained and cultivated, thus a profoundly different type of man would be produced. Similar changes in the action of environment are constantly in progress in nature, since there is no doubt that the changes of environment and the new habits which it so brings about far outstrip all changes in constitution. This fact, which has not been sufficiently emphasized before, offers an explanation of the evidence advanced by Cope and other writers that change in the forms of the skeletons of the vertebrates first appears in ontogeny and subsequently in phylogeny. During the enormously long period of time in which habits induced ontogenic variations it is possible for natural selection to work very slowly and gradually upon predispositions to useful correlated variations, and thus what are primarily *ontogenic variations* become slowly apparent as *phylogenic variations* or congenital characters of the race. Man, for instance, has been upon the earth perhaps seventy thousand years; natural selection has been slowly operating upon certain of these predispositions, but has not yet eliminated those traces of the human arboreal habits, nor completely adapted the human frame to the upright position. This is as much an expression of habit and ontogenic variation as it is a constitutional character. Very similar views were expressed to the speaker in a conversation recently held with Prof. Lloyd Morgan, and it appears as if a similar conclusion had been arrived at independently. Prof. Morgan believed that this explanation could be applied to all cases of adaptive modification, but it is evident that this cannot be so, because the teeth here undergo the same progressively adaptive evolution along determinate lines as the skeleton, and yet it is well known that they do not improve by use, but rather deteriorate. Thus the explanation is not one which satisfies all cases, but it does seem to meet, and to a certain extent undermine, the special cases of evidence of the inheritance of acquired characters, collected by Prof. Cope in his well-known papers upon this subject.

C. L. Bristol,
Secretary.

NEW YORK ACADEMY OF SCIENCES.

At the meeting of the Section of Geology and Mineralogy of the New York Academy of Sciences, held March 16th, Prof. J. J. Stevenson in the chair, the first paper of the evening was presented by Mr. Heinrich Ries on 'A Visit to the Bauxite Mines of Georgia and Alabama.' The speaker first outlined the occurrence of bauxite in Europe and in the United States, illustrating his remarks by means of lantern slides. He then described his trip through the bauxite region of the States mentioned, using the same method of illustration and exhibiting a large series of specimens. Mr. Ries showed the association of bauxite with occasional beds of limonite and lignite and the frequent occurrence of white clays in connection with the ore. In their geological relations nothing of moment was, however, brought to light that has not already been published by Dr. C. W. Hayes in his recent paper in the 16th Annual Report of the Director of the U. S. Geological Survey. In the discussion Mr. R. E. Dodge called attention to the close connection between the bauxite and the tertiary peneplain of the region, so that the ores are not found, except at a point where the great fault lines of the region cut the Knox dolomite between 900 and 950 feet above tide, as shown by Dr. Hayes. Prof. Kemp in discussion called attention to the close association of limonite and lignite with the bauxite, and remarked the close parallel that exists between these deposits and the siluro-cambrian iron ores of the North. In the South we have hydrated oxide of aluminum, with subordinate limonite. In the North the iron oxide is in excess, while the hydrated oxide of aluminum is present only in the somewhat uncommon mineral gibbsite. He also remarked the existence of lignites at Brandon, Vt., and Mont Alto, Pa. While the limonites of the North have been in part derived from the sulphate of iron produced by decomposing pyrites, but little hydrate of alumina seems to have been formed by the sulphuric acid which has also of necessity resulted. Prof. Kemp further remarked that a recent article in the *Engineering and Mining Journal* of March 14th stated that the gossan of the Royal gold mine, near Tallapoosa, Ga., extended a considerable distance below the present water, line and he suggested that it perhaps indicated a recent depression which has brought the oxidized zone below the ground water.

The second paper of the evening was by Mr. R. E. Dodge on 'The Cretaceous and Tertiary Peneplains of Eastern Tennessee,' on the basis of observations accumulated during two summers' field work in the region under Mr. C. W. Hayes, of the United States Geological Survey. The speaker described the geographical development since the cretaceous period of the country lying west from Chattanooga and across the Sequatchie Valley to the Mississippi River. By means of maps and sections Mr. Dodge first set forth the geology of the old cretaceous peneplain now forming the Cumberland Plateau with a few monadnocks projecting above it; next the tertiary peneplain that shows like a great shelf on each side of the river valley; and then the present river valleys and the plains to the west of the plateau region which are now being still further notched by the active streams. A map of the region that the speaker had prepared and colored so as to show the extent of each peneplain, or, in other words, the geographic development, was exhibited and commented upon. In discussion Prof. Stevenson remarked the high terraces that he had met along the Monongahela, Allegheny, Cheat and New Rivers in Pennsylvania and West Virginia. He referred to their uniform attitudes over wide areas and to their occurrences above the river terraces. He seemed to favor, however, the view that they were wave-cut terraces remaining from a period of submergence, but remarked that they were wonderfully well preserved for ones of ancient date, and that they exhibit an extraordinary lack of superficial pebbles such as should accompany a wave-cut terrace.

The section then elected for the ensuing year the same officers that had held office last year, viz: J. J. Stevenson, Chairman, and J. F. Kemp, Secretary.

J. F. Kemp,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 246th regular meeting of the Anthropological Society was held Tuesday, March 3, 1896. Surgeon General George M. Sternberg read a paper on 'Vivisection: Its Objects and Results.'

In the course of his paper Dr. Sternberg said that by dissection of dead plants and animals only can we determine the nature of their functions. The study of the results of disease processes in the post-mortem room cannot settle questions, he said, relating to the etiology of disease, its mode of transmission, if infectious, its clinical history or its treatment. These are questions which concern patient and physician, and scientific medicine depends upon their solution by scientific methods, that is, by experiment.

Progress in the biological sciences calls for experiments on living things. The term vivisection originally related only to cutting operations upon living animals. Its use has been extended by those who have been led to enter upon a crusade against experiments on living animals, so that now it includes all experiments to which they are subjected.

Thus, said the speaker, the injection of bacteria under the skin of a guinea pig becomes vivisection. It is by experiments of this kind that our knowledge of disease germs has been acquired, and without such experiments it would be absolutely impossible to distinguish the harmless bacteria and the deadly germs of tuberculosis, cholera, typhoid fever, puerperal fever, anthrax and the like, which are now well-known in pathological laboratories.

Such experiments have resulted in an immense saving of human life, yet the anti-vivisectionists insist that they are unjustifiable, and would enact measures calculated to entirely arrest all profitable research in this most important department of human knowledge.

Continuing, General Sternberg said that when the dissection of dead plants and animals was first practiced there was great opposition to it on the part of those who did not realize what could be accomplished thereby. One great fault that has seriously retarded the progress of medicine is that there has been altogether too much deduction from insufficient data. This is proved in part in other departments of life by a curious feature of the times, the revival of interest in palmistry, faith cure and matters of that sort, and the absolute reliance which a great many people place in the virtues of patent medicines as panaceas for all ills. If one controverts the views of a believer in any of these he will be met by the recital of some particular incident, unsupported, which answers the purpose of absolute proof to the credulous. This sort of credence is not altogether lacking in the medical profession. Final conclusions cannot always be reached by chemical methods, but much must be done by hospital experiments. These often furnish extremely valuable additions to our scientific knowledge, but it is not always possible to carry these experiments sufficiently far. Fuller and more valuable results may often be obtained by experiments on the lower animals in the hands of a master.

He quoted, in support of his position, the story of one of Pasteur's experiments by means of which, sacrificing the lives of a few animals, he discovered the bacillus of anthrax, and thereby saved the lives of millions of animals. The fact that anthrax inoculation is now so generally practiced was due to Pasteur's work, which could never have been carried through without vivisection. Formerly ten per cent. of all the sheep and five per cent. of all the cattle in France died from this disease, and his study of the malady has resulted in a saving, in France alone, of 5,000,000 francs a year for sheep and 2,000,000 francs' worth of cattle. He also spoke of Pasteur's experiments on the subject of hydrophobia, pointing out the tremendous blessings which have accrued to the human race from the work of the famous French scientist, a work, however, which necessitated the sacrifice of a few animals. As a result of his experiments and study, mortality from hydrophobia among human beings has been reduced to less than one per cent. In a record of 416 cases of people who had been bitten by animals known beyond question to have been mad, treated by the Pasteur method, not one died.

Vivisection has resulted in a great increase in the exactness of medicine and surgery, and any further progress in biology calls for experiments upon living things. In the consideration of vivisection is placed on the one side the tremendous advance in science, the increased immunity from disease and the great saving to the material wealth of the world, while on the other side of the balance is the thought of the animals, comparatively few in number, which have been sacrifìed. As human lives are too sacred to risk in solving the questions of pathogenic potency, we resort to lower animals, and vivisection has resulted in a great saving of human life. The painful dissections made by the early investigators, and necessary in the beginning, are rarely, if ever, made nowadays. The statements presented by the ultra anti-vivisectionists that unnecessary cruelty is used and that many experimenters seem to take an actual delight in the sufferings of their victims, Gen. Sternberg characterized as a gross and unfounded calumny. Vivisection is practiced by members of the humane profession of science in the interest of humanity. Those who deny that any valuable results have ever accrued from vivisection simply show how ignorant they are, and only prove themselves fit subjects for a course of elementary lectures.

The discovery of anti-toxin is one of the blessings that has resulted from experiments upon the lower animals. Scientists would have to stop just where they are to-day if they were prevented now altogether from the practice of vivisection. In securing the anti-toxin, very little suffering is inflicted upon the horse, from which it is obtained, but it must then be tested upon guinea pigs to determine its character and potency. If we object to using guinea pigs for this purpose, then we are compelled to act blindly and must take our chances with the children.

In conclusion, Dr. Sternberg characterized as well meaning, but ill advised, the efforts of those people who seek, by organization, agitation, and in every other way to hinder or absolutely put a stop to a practice which is recognized as necessary to any further advance in scientific medicine.

Dr. Baker considered the question from the physiological point of view. He reviewed the history of the study of the human body from the earliest days down, showing the crude ideas which were entertained on the subject by Hippocrates and other physicians of long ago. He traced the development down to the present time, recounting the experiments which were necessary, and which were made from time to time, without which we would know no more of the functions of the human body than did Galen. Harvey was an enthusiastic vivisectionist, and if he had not been, he could never have discovered the circulation of the blood. That he did discover it resulted from the fact that he cut into the thorax and saw the blood coursing through the arteries and the heart beating. To ask scientists to study anatomy without seeing what is actually within the body would be precisely the same as to ask a man to study the mechanism of a mill by standing outside and listening to the noise of the spindles.

Dr. Salmon, Chief of Bureau of Animal Industry spoke of the role vivisection had played in the discoveries of, 1, Anthrax by Koch, 2, Chicken Cholera bacillus of Pasteur, 3, Immunity as first advocated by the Bureau of Animal Industry and 4, the discoveries and researches in Antitoxin based upon this doctrine. He also cited the million of lives and money saved by the investigations in pleuro-pneumonia, hog cholera, Texas fever and tuberculosis, which had become of international interest, due to the exclusion of our cattle from France to Germany.

Mr. Kennedy, of the Anti-vivisection Society, defined the term 'vivisection' so as not to include inoculation, and claimed that their purpose was to have governmental supervision over experiments, and based his arguments solely on sentimental grounds, claiming that since many experiments had failed therefore it was cruelty to animals destroyed in these unsuccessful attempts.

Dr. Ch. Wardell Stiles spoke of the utility and results of animal experimentation in comparative invertebrate zoölogy as applied to human and comparative medicine. He made the general statements. (1.) That all animals are infested with animal parasites. (2.) That some parasitic diseases may be treated successfully while others cannot; in this later case we must deal with *prevention* rather than *cure*. (3.) A study of the embryological phases of the parasites is necessary before we can establish satisfactory prophylactic measures. (4.) The data regarding the embryology including life-history can be obtained only through animal experimentation.

The speaker next cited some of the better known parasitic diseases of man and the domesticated animals and showed the various steps by which the zoölogist had placed the medical profession in a position to meet these maladies. *Trichine spiralic* (*Trichina spiralis*) was first described in 1835 as a harmless parasite; its life-history was discovered in 1850 but not until 1860 was it shown to be the cause of a well defined disease which up to that time had been confounded with typhoid fever. Its life-history as well as the various prophylactic measures were discovered by experimentation and could have been obtained in no other way. The same is true regarding tape worms and flukes. Through a study of the embryology of these parasites by means of animal experimentation data have been obtained for the proper methods of prevention.

The study of animal parasites bears a close relation in differential diagnosis to the bacterial diseases, for verminous nodular diseases are found in cattle, sheep, chickens, etc., which resemble tuberculosis and are often mistaken for it.

Regarding anæsthetics Dr. Stiles said that they could not be used in his line of work as it was necessary to keep the animals under experimentation for several days, weeks or even months at a time. He was firmly of the opinion, however, that the inconvenience suffered by the animals in experiment was, in the vast majority of cases more of the nature of weakness than of actual physical pain. He claimed that the appetite of the animals was an excellent index to the amount of pain they suffered since an animal in severe pain refuses food. In experiments with animal parasites the hosts nearly always retained their appetites and the speaker maintained that even in the severe experiments the pain suffered by the animals was almost insignificant when compared with the pain a human being would suffer in the same stages of the same diseases.

J. H. McCormick,
General Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 45th meeting of this Society, held in Washington, D. C., March 11th, President S. F. Emmons in the chair, two papers were read, one by Bailey Willis on 'Evidences of Ancient Shores, and the other by David White on 'The Thickness and Equivalence of Some Basal Coal Measure Sections along the Eastern Margin of the Appalachian Basin.'

Mr. Willis discussed the evidences of ancient shores with reference to their position, trend and duration. Five classes of evidence were enumerated: namely, (1) overlap or unconformity; (2) suncracks, trails or ripple marks; (3) coarser deposits; (4) thicker deposits, and (5) synclines of deposition.

Any point of an unconformity marks with precision a point on some shore line at some instant of time, but as the outcrop of an unconformity cannot be assumed to be parallel to the former shore line, this evidence does not define the trend of the ancient shore, and as the shore was in transit its duration was transient.

In contrast with this conclusion was placed that derived from thick deposits of shales such as are formed by the delivery of a large volume of sediment concentrated at the mouth of a river draining an extensive watershed. These conditions result in the accumulation of a lenticular formation which thickens rapidly from the shore to a maximum and thins more gradually seaward. When the thickness of the shale is pronounced, the duration of the conditions was probably long continued. Such evidence, therefore, indicates the approximate position, general trend and long duration of the ancient shore.

In folded regions such conditions of deposition as have just been described have determined the positions of synclines of the greatest magnitude, the synclines of deposition. Such folds are further characterized by a very steep dip on the shoreward side and by the stratigraphy, which should include a massive bed of shale. When sufficiently characteristic to be recognized, the syncline of deposition thus becomes an evidence of proximation to shore, with axis parallel to its general trend; the infolded strata may also indicate the prolonged duration of the neighboring shoreline.

Thus the causal relation which exists between sedimentation and folding is appealed to, to aid in the determination of ancient shorelines.

Mr. David White communicated informally some preliminary results of his recent work under instructions from the Director of the Geological Survey in the stratigraphic paleontology of the lower portion of the Carboniferous proper (Mesocarboniferous) and of the Pottsville series in particular. The speaker exhibited columnar sections of the series near Coxton, Pottsville and Tremont, Pa.; Piedmont, the New River and the Tug River, W. Va.; Soddy, Tenn., and in the Warrior Coalfield, Ala., on which were indicated the stratigraphic position and vertical extent of the paleontologic divisions of the Pottsville series.

Although the plant collections are often fragmentary or represent only one or more levels in some of the sections, the individual collections are generally clearly referable to one of the floral divisions, suggested in the author's preliminary paper on the New River section at the Baltimore meeting of the Geological Society of America, viz: Pocahontas, Horsepen and Sewanee, in ascending order, while the approximate level in that division is also frequently indicated with considerable reliability, as is shown by stratigraphic verification. The limits of these floral divisions, now fairly well determined in the New River section, have been traced through the Flat Top-Tug River section, where the total thickness is seen to expand far beyond the 1,700 feet of the New River section, while material from two localities in the Big Stone Gap, Va., region shows the presence of a flora belonging to the Sewanee division, at a probable height of 2,300 feet above the base of the series, denoting, perhaps, the maximum thickness of the series near this point in the central Appalachian trough.

Special importance attaches to the author's conclusions that the inclusion of the lower part of the 'Walden sandstone' of Hayes, represented by the 'Second Series' of Safford, in the upper or Sewanee division of the Pottsville series is fully demonstrated by the fossils of the West Virginia and the type (Pottsville) sections, while the underlying terranes, including the 'Millstone Grit' and upper part, at least, of the 'Sub-conglomerate' of Safford or the 'Lookout Sandstone' of Hayes are referable to the Horsepen division. Such scanty fossil material from Alabama as is available indicates that in the Warrior coalfield the Warrior and Black Creek seams belong in the Horsepen division, while the Newcastle and Pratt seams appear to fall within, certainly not above, the Sewanee division, though the Pratt seam is said to be about 1800 feet above the base of the series. Such a correlation necessitates placing the boundary of the Lower Productive Coal Measures many hundreds of feet higher in Tennessee and Alabama than has yet been done by the geologists in those States. It also follows that the Lykens Valley coals in Pennsylvania, the New River and Pocahontas coals of West Virginia, as well as the valuable coking coals of Tennessee and Alabama, all seem to fall within the limits of the Pottsville series.

Attention was also called to the absence of the Pocahontas and even the Horsepen division floras in some of the thin sections of the series in this basin, apparently disproving the generally accepted view that the difference between the thick and the thin sections is wholly a question of expansion.

Mr. M. R. Campbell described briefly the result of his recent stratigraphic work in the coalfield of Virginia and West Virginia. From New River to Big Stone Gap his correlations, based entirely upon stratigraphic work, agree essentially with Mr. White's correlations, showing that the two methods are harmonious and lead to the same results.

W. F. MORSELL.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MARCH 13, 1896.

ANTHROPOLOGICAL Section; Charles Morris, Recorder. Prof. T. Edge Kavanagh, of Ursinus College, spoke upon the subject of 'Right-Handedness.' It had been claimed that early man was ambidextrous, drawing of faces facing both ways being adduced in evidence of the fact; but on careful investigation this position had not been sustained. In primitive languages words associated or compounded with the word meaning left hand are symbolic of degeneration. Other data were given to sustain the view that primitive man was right-handed.

Bilateral asymmetry of the human body was not confined to the hand, but is the rule for the entire organism. The right eye was a little larger than the left, the right leg a little longer, the right tibia more calcareous, the right teeth stronger, hair and beard stronger on the right side, while sick headache attacked the left side, as did congenital and defective diseases. The evidence to be adduced from the movements of animals is too scant to be of much weight. The researches of Gratiotet and Brown-Sequard on the development of the human embryo were referred to. It had been suggested that the matter could be explained by the mechanical laws of the body: when the center of gravity is above the transverse median line, the person is right-handed; when median, ambidextrous; when below, left-handed.

Right-handedness he regarded as physiological and not the result of the evolution of a dextral habit. The left side of the brain controls the right side of the body and *vice versa.* The speech center is nearly always on the right side of the brain, the left speech center remaining undeveloped. He regarded right-handedness as a natural physiological development, and he therefore did not regard it as beneficial to cultivate ambidexterity.

Dr. Charles K. Mills thought it probable that in recovery from aphasia the loss of power in the speech center of the brain is not regained by a compensatory action of the other side, but through healing of the lesion in the diseased side. In children aphasia seems to occur equally from paralysis of both sides of the body; in adults from paralysis on one side alone. In aphasia from right-handed paralysis it is very difficult to teach writing with the left hand.

Dr. D. G. Brinton remarked that right- and left-handedness are not found in the anthropoid apes, and there is good reason to believe, from the formation of stone implements and modes of drawing of primitive man, that he was ambidextrous.

Prof. Jastrow stated that the farther back we go the less important the direction of writing becomes. In many ancient methods the writing might be done to right or left, according to the will of the writer. The same is the case with Chinese and Japanese writing. The earliest Greek inscriptions are written from right to left, the direction being changed at a later date.

Mr. H. C. Mercer did not think that the asymmetry of stone implements had any special significance. In stone chipping by modern Indians the grain of the stone largely governed the direction in which it is worked.

Prof. Heilprin called attention to the fact that Darwin had commented on the right-sidedness of a large proportion of animals.

EDW. J. NOLAN,
Recording Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held March 4th, thirteen persons present. Prof. F. W. Putman, in his remarks upon Symbolism in Ancient America, insisted upon the importance of studying Ceramic art from its earlist beginning. The form, color, and style of ornamentation of ancient vessels and utensils was described, and the resemblances between the decorative and symbolic carvings throughout the world noted. Implements made of native copper with the simplest tools were mentioned; also ear and head ornaments made of copper. Carvings upon the round surfaces of human bones clearly indicate design. The designs, methods of carving, and the various meanings of the carvings were explained.

A series of detailed drawings by Mr. Willoughby were also explained. The symbolic tablets of the Pueblo peoples and of the Mound Builders show but slight differences.

The peculiar character of the pottery of the Florida sand mounds was noted. The age of the mounds is uncertain; they are probably more than 800 or 1,000 years.

SAMUEL HENSHAW,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of March 16th Mr. Trelease presented some of the results of a recent study of the poplars of North America, made by him for the Systematic Botany of North America, and exhibited specimens of the several species and recognized varieties. Specimens were also exhibited of an apparently undescribed poplar from the mountains of northern Mexico, which he proposed to characterize shortly, and, for comparison, specimens of the two other species of poplar known to occur in Mexico, and of the European allies of the supposed new species, were laid before the Academy. The paper was discussed by Drs. Green, Glatfelter and Kinner, Mr. Winslow and Professor Kinealy.

The Academy adopted resolutions favoring the appointment of a permanent chief for the scientific work of the United States Department of Agriculture.

WILLIAM TRELEASE,
Recording Secretary.

Erratum: In Prof. Mills' article, page 442, paragraph 3, line 6, for 'smell,' read 'suck.'

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CONTENTS:

MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE NATIONAL ACADEMY OF SCIENCES AND THE COLLEGES OF THE UNITED STATES.

THE National Academy of Sciences was incorporated by an Act of Congress in the year 1863. It consists of 88 members at present, and adds to its numbers annually seldom more than five members, and often none.

The following interesting table shows how its members are distributed among the faculties of the various Colleges in the United States, according to the data available in the Lick Observatory. As our set of college catalogues is not complete a few errors may remain in this list. Professor Hilgard has been kind enough to revise the table before printing. Names in square brackets belong, officially, in another category also.

Albany: Museum of the State of New York, (1): J. Hall.

Albany: Union College (The Dudley Observatory), (1): L. Boss.

Baltimore: Johns Hopkins University, (4): W. K. Brooks, I. Remsen, H. A. Rowland, [S. Newcomb] W. H. Welch.

Berkeley: The University of California, (4): G. Davidson, E. W. Hilgard, E. S. Holden, Joseph Le Conte.

Boston: The Society of Natural History, (1): Alphæus Hyatt.

Boston: The Mass. Inst. Technology, (2): J. M. Crafts, F. A. Walker.

Cambridge: Harvard University, (11): A. Agassiz, H. P. Bowditch, W. G. Farlow,

W. Gibbs, G. L. Goodale, H. B. Hill, C. L. Jackson, E. C. Pickering, F. W. Putnam, C. S. Sargent, J. Trowbridge.

Chicago: The University of Chicago, (1): A. A. Michelson, C. O. Whitman.

College Hill: Tufts College, (1): A. Michael.

Hoboken: Stevens Technological Institute, (2): A. M. Mayer; H. Morton.

New Haven: Yale University, (13): W. H. Brewer, G. J. Brush, R. H. Chittenden, E. S. Dana, W. L. Elkin, J. W. Gibbs, C. S. Hastings, S. W. Johnson, O. C. Marsh, H. A. Newton, S. I. Smith, A. E. Verrill, A. W. Wright.

New York: American Museum, (1): J. A. Allen.

New York: Columbia College, (3): C. F. Chandler [G. W. Hill], R. Mayo-Smith, O. N. Rood.

New York: The Public Library (—): [J. S. Billings].

Philadelphia: University of Pennsylvania, (4): G. F. Barker [J. S. Billings], E. D. Cope, J. P. Lesley, H. C. Wood.

Princeton: College of New Jersey (1): C. A. Young.

Providence: Brown University (2): C. Barus, A. S. Packard.

Washington: U. S. Army, (5): H. L. Abbot, J. S. Billings, C. B. Comstock, E. Coues, C. E. Dutton.

Washington: American Ephemeris, (—): [G. W. Hill], [S. Newcomb].

Washington: U. S. Navy, (2): A. Hall, S. Newcomb.

Washington: U. S. Coast and Geodetic Survey, (1): C. A. Schott [H. Mitchell].

Washington: U. S. Geological Survey (5): G. F. Emmons, G. K. Gilbert, A. Hague, R. Pumpelly, C. A. White.

Washington: U. S. Weather Bureau, (1): C. Abbe.

Washington: Smithsonian Institution and National Museum and Fish Commission, (4): T. N. Gill, G. B. Goode, J. P. Langley, J. W. Powell.

Waterville: Colby University, (1): W. A. Rogers.

Worcester: Polytechnic Institute, (1): T. C. Mendenhall.

In Private Life: (15): A. G. Bell, S. C. Chandler, B. A. Gould, G. W. Hill, C. King, M. C. Lea, T. Lyman, H. Mitchell, S. W. Mitchell, E. S. Morse, C. S. Pierce, F. Rogers, S. H. Scudder, W. Sellers, J. H. Trumbull.

Edward S. Holden.
Lick Observatory,
University of California.

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*DIFFUSIVE REFLECTION OF RÖNTGEN RAYS.**

The following communication contains a brief description of a series of experiments with Röntgen radiance which were conducted during the last six weeks. The results of these experiments seem to possess a sufficient scientific and practical importance to merit notice. The most important refer to diffuse reflection or scattering of Röntgen radiance. It seems desirable to state first, briefly, the disposition of the apparatus and the method of experimentation by means of which the Röntgen effects can be rendered sufficiently intense for the purpose described below.

Induction Coil and Interrupter. A powerful coil was found indispensable for strong effects and satisfactory work. The vibrating interrupter is too slow and otherwise unsatisfactory, and it was replaced by a rotary interrupter, consisting of a brass pulley, 6 inches in diameter and $1\frac{1}{4}$ inches in thickness. A slab of slate $\frac{3}{4}$ inch thick was inserted and the circumference was kept carefully polished. This pulley was mounted on the shaft of a Crocker-Wheeler $\frac{1}{8}$ HP motor giving 30 revolutions, and, therefore, 60 breaks per second. Two adjustable Marshall condensers of three microfarads each were connected in shunt with the break,

* Presented before the New York Academy of Sciences, April 6, 1896.

and the capacity adjusted carefully until the break-spark was a minimum and gave a sharp cracking sound. Too much capacity will not necessarily increase the sparking, but it will diminish the inductive effect which is noticed immediately in the diminished intensity of the discharge. A powerful coil with a smoothly working rotary interrupter will be found a most satisfactory apparatus in experiments with Röntgen radiance.

Edison's Fluoroscope. A fluorescent screen, made by Aylsworth & Jackson, of East Orange, N. J., according to Mr. Edison's directions, will be found an indispensable aid in these experiments. The salt employed is tungstate of calcium and it is so powerful that with a satisfactorily working tube it will show a noticeable fluorescence at a distance of *over thirty feet.* Those who have struggled with barium-platino-cyanide screens will appreciate fully Mr. Edison's improvement. This fluorescent screen was employed successfully for three distinct purposes. First, to study the operation of the vacuum tube under various conditions; secondly, to shorten the time of exposure in photography; and thirdly, to study the phenomena of diffuse reflection.

The most Efficient Working of the Tube—The Critical Temperature. The tubes employed were an old pear-shaped Crookes tube with a cross and several pear-shaped German tubes, imported sometime ago by Eimer & Amend, of New York. They all had discs at each electrode. Very satisfactory tubes are also being made now at the lamp works of the General Electric Company at Harrison, New Jersey. These were also employed in my experiments with completely satisfactory results. No fresh tube works quite satisfactorily with a powerful coil and a rapid rate of interruption; it heats too much, and the vacuum becomes thus rapidly impaired and the intensity of the Röntgen radiance is very much diminished. This is true even of larger tubes. Each new tube must undergo first an electric treatment. I have described this matter at some length at the meeting of the Academy on March 2d. Since that time I have investigated it more fully and brought it to a satisfactory termination. Mr. Tesla has also in the meantime discussed this matter, but in what appears to me to be a somewhat fanciful way. He imagines that the vacuum of a Crookes tube becomes more and more attenuated by the passage of current through it on account of the expulsion of the gas through the walls of the bulb. He maintains that he even succeeded in piercing electrically a small hole in the tube through which the gas from the vacuum was expelled with so enormous a velocity as to prevent the outside air from rushing in. This marvelous experiment does certainly support Mr. Tesla's favorite molecular bombardment theory, but it seems to leave us with the gloomy propect of having to refill our tubes from time to time with a fresh vacuum. The following experiments, however, lead to the conclusion that this necessity will probably never arise and that Mr. Tesla's interpretation of the cause of variation of the vacuum during the discharge is probably wrong. The electrical treatment of the tube is simply this: Pass a sufficiently strong current until the tube becomes so hot as to lose much of its Röntgen radiance. Stop then and let it cool. Repeat the operation and observe that after each operation the vacuum has gone up and that the Röntgen effect becomes stronger. It is not advisable to drive the vacuum much beyond the sparking distance between the electrodes on the outside. But even if this point has been reached then a judicious application of the Bunsen flame to the tube will enable the coil to force and maintain a strong enough current through the tube so as to heat it gradually, which increases the facility with which the discharge passes through the tube. The fluoroscope tells us that there is then a perfectly definite temperature at which the tube will work most efficiently and it is desirable to operate the tube at this temperature. This can be easily done by directing currents of air against those parts of the tube where it heats most, that is, against the parts opposite to the electrodes. By a suitable regulation of the air currents and a careful watching with the fluoroscope the tube can be kept steadily at the temperature of its highest efficiency for hours. A deviation above or below this point will produce a very large diminution in the Röntgen effect. This temperature of highest efficiency is so sharply defined that it looks very much like a critical point in the discharge. Below this temperature the discharge is in straight lines from the cathode and the portion of the glass opposite to the cathode fluoresces much more intensely than the rest. Above this temperature the discharge begins to spread in all directions from the cathode and the whole tube fluoresces strongly. There is then considerable flickering until the temperature is sufficiently above the critical temperature. The tube heats then rapidly and a yellowish mist begins to rise from the anode. As soon as the air blast begins to cool the tube this mist begins to clear away and the whole tube regains a clear transparency. If the tube is made too cool the discharge becomes too faint; there is very little heating because the coil fails to force a strong enough current. The Bunsen burner will assist the coil then to force a sufficiently powerful discharge again. The blackening of the tube by the disintegration of the electrodes seems to be the only thing that will determine the length of its life.

The Combination of a Fluorescent Screen with a Photographic Plate. Photography at a Long Distance from the Tube and through the Heavier Parts of the Human Body.—With an arrangement of apparatus as described above it was found possible to produce very much stronger photographic effects, but not sufficiently strong for penetration through the thigh and the trunk of the human body at reasonably short exposures and at long enough distances from the tube to obtain the desirable clearness in the pictures of these massive parts. A completely successful application of Röntgen's beautiful discovery to surgery depends for the present on a successful solution of the problem just mentioned. I have obtained one satisfactory solution with the method which I first described before the Academy on March 2d. It consists in placing in contact with the photographic plate a fluorescent screen and thus transforming most of the Röntgen radiance into visible light before it reaches the sensitive film. Photographs of the hand were thus obtained at a distance of twenty-five feet from the tube with an exposure of half an hour. At the distance of four inches the hand can be photographed by an exposure of a few seconds. It was in this manner only that I succeeded in photographing on a single plate the whole chest, shoulders and neck of my assistant, with an exposure of seventy minutes and at a distance of three feet between the plate and the tube. The collar button and the buttons and clasps of the trousers and the vest show very strongly through the ribs and the spinal column. This result seems to prove beyond all reasonable doubt the applicability of radiography to a much larger field in surgery than was expected a few weeks ago.

Diffuse Reflection of the Röntgen Radiance.—The question of reflection and refraction of the X-rays is a very important one. It was discussed by Prof. Röntgen in sections 7 and 8 of his original essay. Neither by photography nor by the fluorescent screen could he detect an appreciable refraction with certainty. A reflection from metallic surfaces in the immediate vicinity of a photographic film was detected, "but," quoting Röntgen's own words, "if we connect these facts with the observation that powders are quite as transparent as solid bodies and that, moreover, bodies with rough surfaces are in regard to the transmission of X-rays, as well as in the experiment just described, the same as polished bodies, one comes to the conclusion that regular reflection, as already stated, does not exist, but that the bodies behave to the X-rays as muddy media do to light."

In face of these observations made by Prof. Röntgen, Prof. Rood's and Mr. Tesla's experiments must be interpreted as a confirmation of Prof. Röntgen's results, and not as a demonstration of the existence of a regular reflection. If I understand Prof. Rood's words correctly, no claim is made by him of a discovery of regular reflection; for he says: "These facts and the character of the deformations point very strongly to the conclusion that in the act of reflection from metallic surface the Röntgen rays behave like ordinary light." Mr. Tesla, however, infers with much confidence regular reflection from his theory of bombardment. His experimental method is the same as that of Prof. Rood; that is, he places a reflecting plate at an angle of forty-five degrees to the direct ray and then places the photographic plate at right angles to the direction in which the reflected ray should pass if regular reflection existed. On account of the greater power of his apparatus, his time of exposure was one hour, whereas that of Prof. Rood was ten hours. It is evident, however, that an effect upon the photographic plate does not prove the existence of regular reflection, as Mr. Tesla maintains with much assurance and with much rejoicing over the realization of the prophesy which he made, inspired by his molecular bombardment theory.

In my experiments on reflection I aimed at getting rid of the photographic plate and substituting the fluorescent screen in its place. Two conditions had to be fulfilled to make this substitution possible. First, a very powerful and perfectly steady discharge had to be maintained. Secondly, a very sensitive fluoroscope had to be employed. The first was accomplished by the apparatus and the operations described above. The second was found in Mr. Edison's tungstate of calcium fluoroscope. The tube was placed between two thick planks of pine coated with sheet lead $\frac{1}{16}$ of an inch thick. This screening was found to be somewhat insufficient when the tube operated at maximum efficiency and another screen consisting of a thick copper plate had to be employed. The planks were placed so as to form a wedge around the tube. The cathode streamer was horizontal and passed through a vertical slit formed by the edges of the two screening lead-covered planks. In front of this slit was a fixed pivot on which a mirror could be rotated. The mirror consisted of a polished sheet of platinum pasted upon a rectangular piece of pine board of nearly the same area as the platinum sheet and about one inch thick. The slit was made $\frac{1}{16}$ in. wide and its image examined was by means of the fluoroscope. The tube was six inches from the slit.

a. Quite near the slit the image was sharp and intense. But as the fluoroscope was gradually moved away from the slit its image broadened out somewhat, and there was at each side of it a diffuse border. At about two inches from the slit the image of the slit looked like a wide spectral line upon the less luminous background of a wide band which shaded off gradually into the dark space of the screen. With increase of distance the relative intensities of the two grew more and more equal, and at about six inches from the slit the whole fluorescent screen (about 6 inches by 4 inches) was uniformly illuminated. There was evidently a diffuse scattering of the X-rays in their passage through the air. This inference was confirmed by other experiments which will be discussed presently. Various well-known devices were employed to concentrate the cathode rays along the axis of the tube. So, for instance, wrapping tinfoil around the tube. This, however, did not diminish the gradual diffusion of the image of the slit on the fluorescent screen when the distance between the slit and the fluoroscope was gradually increased. Up to about three inches from the slit the real image of the slit could still be distinguished easily from the diffuse background as a band of maximum intensity.

b. The platinum mirror was now placed quite near the slit and at a convenient angle to the direction of the ray, and the fluoroscope was placed quite near the mirror. There was a faint illumination of the fluorescent screen, but it was perfectly uniform. Not the slightest indication of an image of the slit could be detected, although the distance between the slit and the mirror plus the distance between the mirror and the fluorescent screen was less than the distance at which the image of the slit on the fluorescent screen appeared as a band of maximum intensity when observed directly. A change in the angle of the mirror produced but a small change in the fluorescence of the screen, and then the change seemed to be such as to approach a maximum when the mirror and the fluorescent screen were parallel to each other. The same experiment was repeated with other metals and with the same result. This experiment, therefore, does not speak in favor of regular reflection.

c. Turning the mirror completely around, so that the face of the wooden block on which the metal plate was fastened served as a mirror it was found that the fluorescent effect upon the screen was stronger than with the platinum. A pad of paper of about the same size as the wooden block acted more strongly than the platinum or any other metal. Various substances were tried, like glass, vulcanite, the hand, various metals, and they all produced a diffuse reflection of varying intensity, and at all angles of inclination. In all cases the maximum effect seemed to take place when the broadest side of the reflecting object was about parallel to the fluorescent screen. But the fluorescence was very weak as long as the slit was narrow.

d. The slit was now made wider, and the same series of experiments were repeated with various widths of the slit. The fluorescence of the exploring screen increases, of course, with the width of the slit. The observations made with the narrow slit were confirmed. In every case the maximum intensity on the exploring screen was obtained when the broadest side of the reflecting object was about parallel to the screen. Wood and transparent insulators produced a stronger effect than metals. No accurate quantitative comparisons have yet been made. Among the insulators experimented with, wood produced the strongest effect, and among the metals aluminium is the weakest for the same thickness of the plate. The thickness of the reflecting plate increases the effect; this increase will go on until the reflecting plate is several inches thick if this plate is an insulator. In the case of metals, however, like sheets of iron or copper, the change in the fluorescent effect due to the diffusely reflected radiance ceases as soon as the reflecting plate becomes thick enough to be practically opaque to the direct ray.

e. The human body when in the path of the X-rays will act as a reflector. It is quite an easy matter to detect a person walking across the room in the vicinity of the slit, for as soon as a person crosses the path of the X-rays the fluoroscope will light up. While making this particular observation I noticed that when the tube was operating especially well a faint fluorescence was still present even if no reflecting body was in front of the slit. Precautions were observed to exclude any radiance that might reach the fluoroscope directly by a sort of diffraction around the edges of the slit, but still the fluorescence in the fluoroscope persisted. There was evidently a diffuse scattering of the Röntgen radiance in the air itself. This, however, is so small that it is distinctly noticeable only when the tube operates so powerfully that a strong image of the hand on the fluorescent screen can be obtained by the radiance reflected from a pine board two inches thick and 16 inches square, placed at a distance of six inches from slit. With a good sized tube of proper vacuum and working at the temperature of highest efficiency this intensity is not at all difficult to obtain, provided, of course, that one has sufficient electric power to excite the tube.

These experiments prove beyond all reasonable doubt that the Röntgen radiance is diffusely scattered through bodies, gases not excepted. We may call it diffuse reflection, if we choose, provided that we do not imply, thereby, that we must necessarily assume an internal inter-molecular regular reflection, in order to explain the phenomenon. For if a puff of smoke be forced through a pile of wood some of it will come out pretty well scattered, although we cannot speak here of a reflection in the ordinary sense, but rather of deflection, reserving the term 'reflection' for those particular cases in which the angle of incidence is equal to the angle of deflection. It might turn out, for instance, that the X-rays are due to a circulating motion of ether and that the stream lines are deflected and diffusely scattered within the molecular interstices of ponderable substances. Appearances seem to speak more in favor of this view than in favor of a wave motion of ether.

The diffuse scattering of the Röntgen radiance by bodies placed in its path may be also described by saying that *every substance when subjected to the action of the X-rays becomes a radiator of these rays*. This statement will be more complete than the statement that a diffuse reflection takes place, if my observation should prove correct that the maximum effect in the fluoroscope is obtained when the largest surface of the body, acted upon by the Röntgen radiance, is placed parallel to the fluorescent screen. For in that case there is actually secondary radiation due to the diffuse scattering which proceeds normally to the surface of the intercepting body.

The fact that opaque bodies like metals are less effective in producing this secondary radiation leads to the conclusion that there is in these bodies an internal dissipation of the Röntgen radiance much greater than in the case of transparent dielectric substances. A properly constructed bolometer should give us much information on this point, and it is my intention to take up this subject as soon as time and facilities will permit.

These diffusion effects, which are present even in air, bring the Röntgen radiance into still closer resemblance to the principal features of the cathode rays which were studied by Professor Lenard. The difference in their behavior towards magnetic force is still to be explained. Is it not possible that this magnetic effect in air is masked by the diffuse scattering of the X-rays?

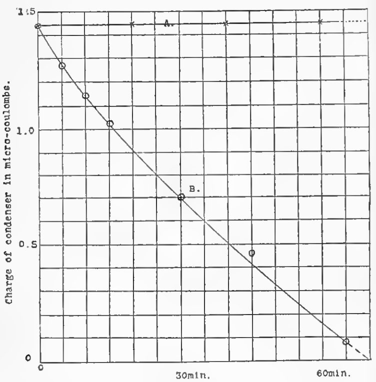
In conclusion I wish to observe that among the several theories proposed to account for the properties of the X-rays we may insert one which can be easily inferred from the somewhat neglected essay which the late Prof. v. Helmholtz wrote toward the closing days of his life. It is the essay, 'Inferences from Maxwell's theory concerning the motion of pure ether' (Wissenschaftliche Abhandl. B. III., p. 526, Wiedem. Am. Vol. LIII., p. 135–143).

M. I. PUPIN.

COLUMBIA UNIVERSITY, April 2, 1896.

A METHOD OF DETERMINING THE RELATIVE TRANSPARENCY OF SUBSTANCES TO THE RÖNTGEN RAYS.

THE fact that the Röntgen rays have the power of dissipating the charge of a perfectly insulated electrified body was established by Professor J. J. Thompson,* and furnishes us one of the simplest methods of detecting the rays. This effect is the basis of a very simple method of making quantitative measurements of the intensity of the radiation. If we take a condenser and allow the Röntgen rays to fall upon it, we shall find that there is a very considerable diminution in its insulation resistance, and that the charge of the condenser is gradually dissipated. This is illustrated by the



Time between charging and discharging condenser.

curves A and B in the accompanying figure. A was obtained under the ordinary conditions. B was obtained when the Crookes tube was in action, and placed about six inches from the wooden side of condenser. The curve A was determined before, and again immediately after the determination of B. The two determinations of A were identical, showing that the effect of the Röntgen ray on the insulation disappeared with the cessation of the ray. In making these measurements a Nalder micro-farad condenser was used, the condenser being charged with a standard Clark cell. It is evident, therefore, that it is possible to compare the transparency of different substances by allowing the rays to pass through screens made of the substances and placed between a Crookes tube and the condenser and measuring the resulting leakage of the condenser.

* London Electrician, February 7, 1896.

I am now engaged in making a series of measurements, using this method and a condenser especially constructed for the purpose, and hope to give the results in a subsequent number.

It would seem that the method is capable of giving results much more quantitative in character than any that can be obtained by photographic methods.

WM. LISPENARD ROBB.

TRINITY COLLEGE, March 25, 1896.

AN APPARATUS FOR THE STUDY OF SOUND INTENSITIES.

THE study of sound intensities presents many difficulties to the physicist as well as to the psychologist; the determination of the equality of loudness of two sounds, as well as of the law of relation between the physical cause and the sensational result is perhaps the most serious one. The facts that sounds must be estimated successively and should be of a constant intensity from beginning to end further complicate the problem. The method of the falling ball has been most frequently used; it consists in dropping a ball successively from two different heights and recording the minimum difference in height necessary to enable the observer to determine which fall gives rise to the louder sound. The objections to this method are many and obvious; it answers well enough for a demonstration, but not for exact research. A second method consists in moving an object producing a constant sound, such as a ticking watch, or a tuning fork, uniformly towards or away from the ear, and recording the minimum change in position, that enables the observer to determine whether the sound has grown louder or lower. This has advantages over the falling ball, but is far from satisfactory; and both are alike limited in the scope of their applicability. There is also an electrical apparatus, an audiometer, that is useful in determining the sensitiveness to minimal sounds, but is not so satisfactory for determining differential sensibility; the sound moreover is very artificial, difficult to listen to, and difficult to reproduce. A common defect of all the methods is the difficulty of determining by an objective test whether the sound produced by the apparatus on one occasion is really the same in intensity as in a succeeding trial.

It was in the attempt to secure a means of gradually increasing the intensity of a sound, just as the siren gradually changes the pitch, that I succeeded in devising a moderately satisfactory apparatus for this purpose. No apparatus can be regarded as completely satisfactory unless its operation depends upon a principle that clearly establishes the relation between the physical stimulus and the sensational result. Unfortunately the physicist is not as yet ready to define and measure the various factors contributing to the tones produced by the the apparatus about to be described. In the absence of such knowledge the apparatus can be proposed only as an empirical solution of certain phases of the study of sound intensities. The apparatus makes use of the principle of the singing flame. A singing flame consists of a very fine jet of gas, burning through an aperture of about one millimetre, under a long, narrow glass tube; the pitch of the resulting tone varies in an inverse sense with the size of the tube. (For details see Tyndall, *Sound*, Lecture VI.) The sound is due to the vertical vibrations of the flame, the pitch being determined by their frequency and the intensity by their amplitude. The amplitude, however, can be directly observed; the flame is first turned down until the sound just ceases to be heard, and this point is noted on a millimetre scale placed in back of the flame; when the flame is turned up to any given point the intensity of the resulting sound is clearly marked by the amplitude of the flame, as determined by the height of the flame above the zero point just described.

The other requisite of the problem is a means of delicately regulating the flow of gas and thus the intensity of the sound. This was accomplished as follows: An ordinary steam valve was taken apart and the coarse thread adjustment replaced by a fine one ($\frac{1}{40}$ inch), at the same time giving the end of the pin a delicate taper; the handle of the valve was then firmly fixed to the center of a wheel ten inches in diameter; this larger wheel was moved by the friction of a smaller wheel one inch in diameter, having at its center an index moving over a dial eight inches in diameter. In this way a movement of the index along the circumference of the dial magnified about 100 times the change in the height of the flame. The height of the flame is first determined for a few points by sighting it through a lens, and the divisions of the dial are then made accordingly.

One further difficulty remained, namely, to secure a constant pressure of gas. This was accomplished with sufficient accuracy by forcing the air out of a bell jar (fitted with a gas cock at its neck) by immersing it in water, and then filling it with illuminating gas from the city supply. The movement of the bell jar as it descended into the water, and thus forced the gas to the flame, was carefully guided and the weight of the glass jar itself exerted a sufficient pressure. The apparatus is extremely sensitive and must be kept free from vibrations and draughts of air.

The use of the apparatus in the experiments for which it was designed is to determine the minimum change in the amplitude, the nature of which, *i. e.*, whether an increase or decrease of intensity can be detected. A sound of an agreeable intensity (and determined by a constant height of the flame) is taken as a starting point, and the subject informed that this sound will very gradually increase or decrease in loudness; he listens carefully with his head in a fixed position and answers as soon as he is confident of the direction of the change. The operator slowly moves the index in one direction or the other, takes the position when the answer is given and also the time of the experiment.

How far this apparatus will be serviceable for other methods of studying the sensibility to sound intensities is in some measure still to be determined. It may be noted, however, that it lends itself readily to determining absolute sensitiveness to sound; for one has only to note the minimum height of flame giving rise to a just audible sound with the head at a fixed distance from the apparatus. For the method of just observable difference one may have the flame sound, stop it, and sound it again with a slightly modified intensity until the difference between the two sounds becomes perceptible. For the method of right and wrong cases the same mode of use is available, except that the difference between the two sounds in any one series of experiments remains constant. By the method of the average error one should have two singing flames sounding alternately, the subject attempting to set one of them so that the sound it emits equals in intensity the standard sound. To all these applications there are as yet two objections: First, the sound does not begin immediately after the flame is allowed to play, but takes a considerable time to rise to its full intensity. The sound may be stopped instantly by suddenly lowering the flame, or placing a card at the top of the glass tube; but its inertia in starting introduces a disturbing factor. The second objection refers to the difficulty of constructing two such pieces of apparatus exactly alike, so that two flames vibrating with the same amplitude may be regarded as giving out sounds of equal intensity. Neither of these difficulties is insurmountable, and it is to be hoped that they will be solved as occasion demands.

In concluding, it may be well to indicate again that the success of the apparatus is due to the fact that the change in amplitude, and hence in intensity, can be directly observed; secondly, that the sound is fairly pure, of a definite pitch, agreeable and continuous; and thirdly, that it may be most delicately changed. All these advantages result from the use of the singing flame as a source of sound.

JOSEPH JASTROW.
UNIVERSITY OF WISCONSIN.

HOW NATURE REGULATES THE RAINS.

WHEN American enterprise invaded with its iron cavalry the mountain regions of the West, many established theories were put to new tests and not all sustained themselves. The relations of plant life to water supply as found on the eastern half of the Continent had led our fathers to believe that the destruction of forests would invariably and inevitably result in the depletion of adjacent streams and to all consequent evils. So potent is the thick shade which covers the ground in many parts of the Eastern States that no one imagined that conditions existed elsewhere which would produce entirely different results. The building of long lines of railroads and the opening up of mines have led to the cutting off to the very ground, of extensive tracts of timber, and the effect upon local streams has forced observing people upon the spot to the conclusion that nature has surer and wiser methods than she has been given credit for. That she has storage facilities among the mountain tops, capable of resisting the attacks of any human vandals and that the fountains of her rivers will be preserved to send down the precious floods throughout all future time, regardless of what man may say or man may do.

Any discussion of such a question among those who have looked at it from any certain standpoint will be met by the suggestion that close measurements extending over long periods of time and covering widely separated points will be necessary in order to prove anything, but the question whether snow lasts longer before or after the timber is removed can be considered without going into any of the difficult theories as to whether the fall of moisture is or is not affected by trees. In all such things a great many small considerations go to make up the great answer. Scientists point to a whole list of phenomena each one of which, by itself, would hardly have been felt, but each supporting all the rest and all coming together, produced the glacial age, and they say that when they all drop in together again at any future time, the result will be the same and miles of ice will pile up on the surface or the earth. In a small way the same is true in meteorology, and it is with an effort to give to each its due weight that I endeavor to point out some of the reasons why many close observers, after long years of study, have been led to believe that if there is any difference in the flow of streams and the size of springs before and after the trees are cut from above them, the balance is in favor of the open country.

That water which drops on shaded ground which is thickly overspread with spongy leaves and the air so near the dew point that it cannot absorb much more moisture should be held back, while that coming down on open ground should run off quickly, seems very natural, but in high mountain regions there are peculiar combinations which do much to modify the action of the law. The pine and the fir are the only trees found growing at high altitudes in any abundance, and their thin needles do not make the heavy shade when on the tree, nor the thick mat when lying on the ground, that the broad leaves of the oak, beech and maple do. Instead of forming a spongy layer five or six inches thick, they are swept about by the wind and it is not unusual to see the ground bare under the trees and all the needles lodged somewhere in drifts. Even when they lie where they fall the coating is comparatively worthless so far as retaining moisture is concerned.

On the other hand, the foliage on this class of trees being as heavy in winter as in summer, the branches catch an immense amount of the falling snow and hold it up in mid-air for both sun and air to work upon, and only those who have had experience of the absorbing power of the dry mountain air can form any idea of the loss from that source. Such as is melted falls upon that beneath, and breaking the surface sets in operation the forces which are always ready to attack such substances. The theory that the shade protects the moisture laden soil means but little in such places. The law is doubtless in force with more or less strength wherever moisture falls and plants grow, but the class of trees that thrive here require a loose, sandy soil, and are often seen growing where there is no earth in sight at all clinging to the sides of cliffs, so bare that the roots run along on the surface entirely uncovered until they reach some crevice which they fill, and send tendrils down to draw sustenance from an unseen source. In such places the melting snow disappears quickly from the surface, and, except for their influence in keeping the soil light and porous so that the water can be absorbed readily instead of running off, it matters but little whether trees are there or not. No moisture remains on top of the ground long for shade to protect. It goes either into the air or else into the ground, and it is a well known fact that a very large portion of the water which finds its way down the steep sides of the Sierras disappears near its sources and is found again far below, either in springs, by means of artesian wells, or in the increased flow of the parent stream. Indeed, a number of very respectable rivers, not only in the mountains, but in some of the valleys, seem to owe their existence to such distant and hidden sources. If the trees have any direct power here it seems to be to draw from deep beneath the surface the moisture which has sunk into the earth and exhale gallons and gallons of it hourly. Any good sized tree has been estimated to have a capacity of forty or fifty gallon every twenty-four hours, and a forest of such trees would effect very considerable results. I should like to offer the opinion of Captain J. B. Overton, of Virginia City, Nevada, just here. He has had control of the water supply of that city for many years, and also conducted large operations in the mountains in cutting timber, wood and lumber, for the mines. His experience covers a quarter of a century and extends over several townships of land, from which his men cut the timber. He says "My experience proves to me that the cutting of the timber makes no difference in the amount of snow that falls, but that it drifts more, and for that reason lasts about as late in the summer as it would before the removal of the shade. I do not think the streams get low any sooner or afford any less water. I am of the opinion that the trees absorb from the soil quite as much water as would be evaporated by the action of the sun in the absence of shade. I know two small springs that ran for the whole year for ten years after the land was cut over, but, that since the thrifty growth of young pines have reached a height of from 15 to 25 feet and shade the ground as well, if not better, than the large trees did, have dried up about the last of August for five years past, and I can see no cause for it except that the trees are using the water. The supply of water used by my company in its operations has not decreased with the disappearance of the timber, and I do not find that the freshets are any more frequent or more violent than before the trees were cut off. The trees are coming up in a second growth much more numerously than they were before, and after sixty or seventy years about nine-tenths of them will die off and decay, leaving the timber about as it was when we first came to the country; then I think my springs will flow again. My observation teaches me that the amount of rainfall is not affected by denuding the mountain-side, but that the surface of the ground will be heated more by the sun and will therefore be drier, but that the springs and streams will be more diminished by the water used by the trees than by evaporation in their absence."

In a timber belt the snowfall is comparatively evenly distributed and by the radiation and reflection of heat from its own body each particular tree immediately sets itself to work to clear the ground around it, and long before there is a vacant foot out in the open a space will be bared for several feet around each trunk. So long as there is no color but pure white for the sun's rays to work upon its heat is largely latent, but let a stick or straw break the surface and it will melt the snow or ice for several times its diameter on every side and stand alone in a few hours. Precisely the same is true upon a larger scale of every stump and tree in a forest. Following the reappearance of the sun after every storm the process begins, slowly or rapidly according to the temperature, clearing up large patches before that beyond shows signs of a break. This is not theory or hearsay, but actual observation covering a score of years spent in daily contact with the subject in all its phases. But it is supported by a theory also. It is a well known fact the temperature in a forest is always several degrees higher than it is on open ground under the same conditions otherwise. A series of observations were made by Cornell University several years ago, and although the belt of woodland was only half a mile long and sixteen rods wide the results were very marked. The trees were oak, maple and chestnut, with some hemlock and pines intermixed with an abundant undergrowth. The thermometers were changed and one put in another's place frequently in order to detect possible errors. The reporter sums up as follows:

"A study of the records will show that the temperature of the wooded belt is somewhat higher than that of the open field, amounting to from 2 to 4 degrees on the average; that fluctuations are less extreme and less rapid, and that gradual changes in the temperature of the field do not affect that of the belt until a day or two later."

Five different stations were kept open for several months; one thermometer being placed against the trunk of a large oak tree, near the center of the woods; one near the same tree, but not touching it; a third on a pole four feet from the ground, ten rods from the edge of the woods, and two others in the trunks of trees. A considerably warmer temperature was shown by the instrument suspended from the oak tree, but not touching it, although on several days the one out in the field was exposed to the sunshine, while the others were in the shade all the time. Of course the higher temperature would have a two-fold effect upon a snow bank. The warmer the air, the greater its capacity for holding moisture and, consequently, the greater evaporation, and at the same time its melting power would be enhanced to that extent and the snow set to running away as water. Too little weight is generally given to the fact that the rays of the sun must be broken up in order to release heat. A good example is given every spring by John Huntington, who is the owner of the toll road extending from Truckee, California, to Lake Tahoe. The snow shuts this road up very early every winter and a deposit of twenty to thirty feet is nothing unusual. As soon as possible, in the spring, Mr. Huntington sprinkles black dirt on the surface of the snow above where his road is known to be and the effect is wonderful. The layer is not heavy enough to shut out the light from striking the surface of the snow, but it is ample to release the heat rays, and there is a long depression that looks like an artificial excavation in a few hours, and days before the ground is clear on either side the stages are running on bare ground.

Trees tend to dissipate the snows in springtime also, by breaking up the steady cold winds which come down from the north at that season, almost invariably. When the current is permitted to flow on in uninterrupted sweep it retains the chill, but let it strike a forest and wind in and out among the trees for a mile or two and there will be a decided change in its temperature. It will be much better prepared to absorb moisture and also to melt the snow banks in its changed form, as it pursues its southern journey.

But the strongest force at work to save our rivers is the drifting winds which heap up the snow in great banks, and in this the trees are a constant obstacle. There will be miniature drifts, it is true, but nothing to what there are when there is no obstruction. Outside the timber belt, where there is nothing to catch the snow as it falls and nothing to break the force of the wind, one of the most powerful and active agents in preserving the water supply of a country comes into play. By forming solid bodies of snow the most effective means of saving water for summer is reached. Across the bleak summits and down the vast canyons the wind has a well-nigh irresistible force and it not only gathers up the snow after it has ceased to come down, but it usually keeps at work all the time it is falling and carries it in whirling clouds until it strikes a cliff or a canyon set at just the right angle, and there it deposits the whole load. As long as there is any material left outside to work upon this is kept up, and there is no knowing how deep some of the big drifts get to be in the course of a long winter. As the days get warmer, the surface thaws a little and moistens the cake down a few inches, but the cold nights found all the year around at such altitudes soon transform it into ice, making a crust upon which the heat of the sun and the absorbing power of the air find it difficult to make any impression. On open ground the process is aided by the packing power of the wind, and it is not an unusual sight to see a man on horseback traveling comfortably across snow banks high enough to hide both the horse and his rider many times over if they should chance to break through. It is this which has changed the opinion of four settlers out of five along the eastern base of the Sierra Nevadas, where the timber has been cut for the Comstock mines. Over half a billion dollars in treasure have been taken from that one lode, and it is said that for every ton of ore taken out the equivalent of a cord of wood has gone in either in the shape of timber or of fuel. The whole mountain side for a distance of thirty miles has been cut over, covering the heads of such streams as Hunter's Creek, White's Canyon, Thomas Creek, Galena, Steamboat and other small rivers, which have furnished water for irrigation since 1860 to the owners of probably twenty thousand acres of land in valleys below. The concensus of opinion among this class of citizens, intelligent American farmers all of them, is that there is virtually no diminution in the supply of water that reaches them from the hills. James Mayberry had charge of men who cut over 12,000 acres in the early '70s. He is of the opinion that Hunter's Creek, with which he is most familiar, has a more certain flow and somewhat more water than before. John Wright has lived for thirty years on Steamboat Creek. It was dry in 1864, when the timber was standing, but never has been since, and has furnished water for a constantly increasing settlement. Robert Jones lives on low land and says he has had more crops killed by flooding in the ten years after the timber was cut than in the ten before it was touched. G. R. Holcomb says the supply is equally certain if not more so and attributes it entirely to the drifting of the snows. Several made answer that the water melted earlier and ran off sooner and said any one would know that, but failed to convince even themselves that they were lower than in former years.

Hon Ross Lewers, of this county, read a paper before the American Horticultural Society a few years ago in which he said: "There are certain peculiar conditions that prevail in Nevada that I think are worthy of notice. One of them is, that wherever the forest timber has been cut off, a new growth has sprung up much thicker, and none of the young trees will start until the old ones are gone. Another is that the water supply from the mountains is greater and more permanent now than it was before the timber was cut off. The reason for this is that the wind has a more unimpeded course, and as all the snow storms come from nearly the same point in the south the snow is blown over and lodges on the north sides of the ridges where it is piled deep in drifts, and not being exposed directly to the sun's rays it melts very slowly and thus affords a more permanent supply. Spring floods are less frequent and for the same reason. I do not pretend to decide how much, if any, the presence of trees induce precipitation. They may moisten the air, but the humidity is all taken out of the ground by the roots, and I observe that the undergrowth and grass is more luxuriant since the timber was cut off."

It is hardly necessary to point out the advantage of having the snow supply heaped up in large drifts or buried deep in the canyons rather than to have it spread out, exposing large surfaces to the sun and the dry air, which in such places is almost constantly in motion, thus multiplying its capacity. In drifts the melting is almost all done at the bottom, and far into the summer a little rill will be found running away from the lower side. Good sized caves are often formed in this manner, and sometimes the top crust is so solid that the last seen of a big drift will be an arched shell of frozen snow reaching from one wall of the canyon to the other. The beautiful adaptation of the means to the end seen everywhere in nature is illustrated here. To attempt to hold back an adequate supply of water for a great region like that lying below the Sierra Nevada range in any except a solid state would be utterly useless. Nothing in a liquid form would tarry long on a heavy grade. No shade nor mat of leaves would be strong enough to overcome the law of gravitation to that extent. Nothing could detain it but a short time at the farthest, and if it were not for the vast drifts which hold the snow in an icy grasp until late in the summer, all the horrors prophesied from spring floods and summer droughts would be realized. As it is, I notice that heavy storms continue to visit the places from which the timber has been taken, but when an unfavorable season fails to bank up the drifts there is no water in the streams whether there are trees or stumps on the ground. There are places in Nevada which would give a strong support to the theory that the cutting off of timber brings frequent floods, if any had ever been there, for since the settlement of the country there have been several terrible floods which have been given the name of cloudbursts on account of the suddenness of the rise and subsidence of the water. The town of Austin, Nevada, is a sample. It has been swept several times by sudden floods, and as it lies in a narrow canyon which opens out above and spreads into quite a watershed, it is in constant danger. There never was a forest there and in early days there were no cloudbursts, but the discovery of rich mines led to the whole basin being tramped over and over constantly until the ground was as hard as a pavement. The result was that rains which formerly were taken into the soil ran down the waterways into the main canyon, which soon collected a roaring torrent and swept everything out. In so large a subject there are many things to consider and many unknown quantities to discover and weigh, but it seems to me that it is worthy of more attention than it has received. My observations, while they have extended over a long series of years, have been those of a layman and have not been such as to afford mathematical proof, even that a given quantity of snow, say a foot, will last as long on open ground as it will among trees. As I have laid much stress upon this matter of evaporation which some may think hardly applies to snow, I will say that a considerable body has been known to disappear from our streets without making a particle of mud, leaving the ground dusty, showing that none of it melted, but that it all went directly into the air. And this will occur any time when the thermometer does not go above 32 degrees within a short time after a storm. The importance of presenting as small a surface to the action of such an air as that is very apparent, and it is in storing up the snow in heaps and packing it away in deep pockets that the economy of nature is manifested. The center of the body will not melt at any time and it requires a very warm day to get at the under side of a snow drift. The grass will be growing all around it before the ground underneath it gets warmed up sufficiently to start a stream from it, but let a tree stick its head up through the crust and it will go quickly. I have yet to see the first body of perpetual snow lying among trees. It will hardly do to say that the timber lies below the line of perpetual snow, for there are many banks which only disappear entirely once in ten years or so, when there comes a long dry summer, which have trees growing higher up on the same mountain side.

In any case I do not wish to be understood as favoring the destruction of the forests of this or any other country. I never cut down a tree in my life and never saw one fall without feeling that I had lost a friend. Whatever is proven there will always be abundant reasons for preserving extensive tracts of woodland everywhere that trees will grow, and it is time the matter became one of public concern.

R. L. Fulton.

Reno, Nevada.

CURRENT NOTES ON ANTHROPOLOGY.

THE QUESTION OF THE CELTS.

This question has broken out afresh in Europe, as is the case every few years. The immediate cause was the publication of an essay, by A. Bertrand and Salomon Reinach, entitled, 'Les celtes dans les Vallees du Po et du Danube,' in which the authors claim that the proto-historic culture, the remains of which are found in the valley of the Po, is akin to that of an approximate age in the valley of the Danube, and that both were the products of the 'Celts.'

Prof. Virchow, in a lecture published in the 'Correspondenz-Blatt' of the German Anthropological Society, December, 1895, reviewed their arguments, substantially agreed with them, and further extended the area of this so-called Celtic culture.

By 'Celts' the archæologists understand a series of independent tribes who about 500—1,000 B. C. inhabited central and portions of western Europe. Their language was of that Aryan family which we now know as Celtic, represented to-day by Irish, Highland Scotch and Welsh. In stature they were tall, their skulls narrow (dolichocephalic), their complexion ruddy, eyes blue or gray, hair blonde or reddish. By the Latins they were called Celti, Galli or Galatæ, all three words from the same root *kel*, meaning violent or warlike.

The anthropologists, however, headed by Broca, apply the term 'Celts' to a small dark race in central France, and this leads to wild confusion. A long discussion, aimed to clear up the subject, by Dr. Lefevre, Dr. Collignon, Mortillet and others, has appeared in the Bull. de la Société d' Anthropologie of Paris, 1895. It is worth attentive reading by any one who desires the latest on this vexed question.

DANISH ANTIQUITIES.

Professor Japetus Steenstrup, of Copenhagen, has lately issued two memoirs of much interest to students of Northern antiquities, both published in the 'Memoires de l'Academie Royale des Sciences de Danemark.'

One is a discussion of the remarkable so-called 'silver vase' exhumed in 1891 at Gundestrup. Upon its sides were numerous singular figures in relief, and it has generally passed as an example of old Norse work. This view is disproved by Professor Steenstrup, who shows that without doubt it is part of a series of decorations from some Buddhist temple in northern Asia. His memoir is abundantly supplied with plates and illustrations showing the identity of motives. It probably was a part of the spoils of some ancient raid which by exchange had reached the western shore of the continent.

His second memoir is another study of a similar character, bringing out the relations which in proto-historic times existed between Scandinavia and northern Asia. It is entitled 'Yak-Lungta Bracteaterne,' and contains numerous illustrations of gold bracteates from the two regions, showing the same character of design and workmanship.

D. G. BRINTON.

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SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

THE February number of the Monthly Notices of the Royal Astronomical Society, copies of which have just been received, contains the annual reports of the directors of the British observatories for the year 1895. Many of these reports are very interesting, and they show that the customary astronomical activity has not decreased. The routine meridian observations and those of comets, etc., have been carried on with the usual success. Nearly all the plates for the astrophotographic catalogue, and some of those for the chart, have been taken at the Greenwich, Cape, Oxford and Sydney observatories. The work of measurement has also made quite satisfactory progress. We quote the following from the Greenwich report:

"Towards the determination of the right ascensions and declinations of the stars the following steps have been taken: From the right ascensions and declinations given in the catalogues of the *Astronomische Gesellschaft*, 'standard coördinates' have been deduced for all stars on 72 plates which are contained in these catalogues. (By standard coördinates are meant the rectangular coördinates of the stars on the plates.) By a comparison of these with the measured coördinates, plate constants have been determined, from which the standard coördinates of other stars on the plates may be obtained by means of a linear correction, and the right ascensions and declinations deduced by a trigonometrical transformation, if desired. A full account of this, as well as the comparison of thirty overlapping plates, is given in the Monthly Notices, January, 1896."

The above shows that the reduction of the catalogue plates is well under way at Greenwich. The same is true at Oxford, and, as we mentioned in a previous issue, it is also proceeding satisfactorily at Paris and Potsdam. At the Cape considerable measuring has also been done. But the most important announcement from the Cape is as follows:

"The printing in two volumes of 'A Determination of the Solar Parallax and the Mass of the Moon from Observations of Iris, Victoria and Sappho,' is approaching completion. The part of the work referring to the meridian observations of the comparison stars is by Prof. Auwers, that of the discussion of the heliometer observations of Iris by Dr. Elkin."

We have not space to refer to the many details given in the reports of the various observatories. But they are all interesting, and will repay perusal by astronomers. The Society's medal was conferred upon Dr. S. C. Chandler, of Cambridge, Mass., as has already been announced in this journal.

THE *Astronomical Journal* of March 31st contains an article by Prof. Simon Newcomb on the 'Variation of Personal Equation with the Magnitude of the Star Observed.' This is the first attempt to make a general discussion of this rather obscure point for a large number of star catalogues. It has been known for sometime that the right ascensions of faint stars differ systematically from those of the brighter stars, on account of a peculiar form of personal error in making the observations. Prof. Newcomb now determines the amount of this personality *per magnitude* for twelve of the principal catalogues.

It was not possible to treat the observations of each observer separately, but each catalogue was dealt with as if it were the work of a single observer. The catalogues were compared in pairs. Sixteen such pairs were treated, and for each pair the relative variation of right ascension per magnitude was computed. The results so obtained were adjusted so as to get the variation per magnitude for each catalogue relatively to the great Paris catalogue. The latter was adopted as a standard of reference because it occurs in a majority of the pairs of catalogues treated.

The relation of the Paris catalogue to the truth could be determined by the aid of the results previously obtained by Gill, Küstner, Boss and Becker. The following remarkable result was reached:

The variation per magnitude of the right ascension averaged very nearly one-hundredth of a second of time, no matter whether the observations were made by the eye and ear method or by means of the chronograph.

H. J.

GENERAL.

WE learn from the *Botanical Gazette* that plans for the Hull Botanical Laboratory of the University of Chicago have been completed. The building, of four stories and in addition a large roof greenhouse, will include a library, lecture rooms, laboratories and private research rooms for morphology, physiology and taxonomy. As already stated in this JOURNAL, Prof. John M. Coulter, senior editor of *The Botanical Gazette*, has accepted the head professorship of botany. As, however, the building will not be completed before April, 1897, the botanical staff will not be fully organized until the following autumn. With the present issue the *Gazette* passes into the possession of the University of Chicago. The same editors will remain in charge and the general plan of the journal will be the same. The editors "wish it to be clearly understood that the *Gazette* is not to be the organ of the botanical department of any university, but that it belongs to all botanists everywhere. Its relation to the University of Chicago is simply to bring it that permanence and possibility of development which the present condition of botanical science demands."

THE annual report of the Secretary of the Geological Society of Washington states that there were held during the year 1895 fourteen meetings of the Society, with an average attendance of 35, exclusive of the meeting at which the annual address of the President, Mr. G. K. Gilbert, was given. 38 communications have been presented during the year, 29 of them being announced upon the programs of the meetings and 9 being offered in the informal half hour. The various communications were presented by 27 different members. There are now 111 active members and 38 corresponding members in the Society.

THE Fort Pitt Street Railway Company of Pittsburg has given $100,000 for a zoölogical garden at Highland Park.

THE bill reported from the Committee on Coinage, Weights and Measures of the House of Representatives adopting the metric system of weights and measures as the legal standard in the United States has been defeated in a preliminary vote, which stood 80 to 65.

PROF. RAMSAY has in preparation a book which will shortly be published by Macmillan & Co., treating the gases in atmospheric air and especially the discovery and subsequent investigation of Argon.

THE Berlin Academy of Science has elected as corresponding members, M. Poincaré, professor of mathematical physics in Paris, and Dr. G. Neumayer, director of the German *Seewarte*.

THE Director of the Lick Observatory has recently received from the Minister of Foreign Affairs of the United States of Venezuela the diploma and decoration of the order of Bolivar, the Liberator. This order was founded in 1825 by Peru and adopted in 1854 by Venezuela.

It is conferred, in this case, for services to science. Dr. Holden had previously received the decoration of Commander of the Ernestine Order of Saxony (founded in 1690) on the same grounds.

THE Presidency of the Royal College of Physicians of London, regarded as the highest honor that can be conferred on a British physician, will probably be filled by the election of Dr. Wilkes, who in the election of 1893 stood next to the ballot of Sir J. Russell Reynolds, the retiring President.

THE Committee on Agriculture of the House of Representatives has reported favorably the bill creating a special commission on highways, to consist of the Chief of Engineers of the Army, the Director of the Geological Survey, and the Chief of Road Inquiry of the Department of Agriculture. The Commission is to consider, among other things, the best methods for the scientific location of highways on the public domain; the employment of the Geological Survey in the discovery of road materials; the free testing of all road materials offered; the construction of model roads, and instruction in road-making at agricultural colleges and experimental stations.

THE admirable article by Prof. William James, of Harvard University, on 'Is Life Worth Living?' in the October *International Journal of Ethics*, has been republished in book form by S. Burns Weston, Philadelphia.

D. APPLETON & CO. announce for publication a work by Prof. John Trowbridge, of Harvard University, entitled 'What is Electricity?'

THE third International Congress of Dermatology will be held in London from August 4th to 8th inclusive, under the Presidency of Mr. Jonathan Hutchinson.

A SERIES of lectures has been arranged to be given at Berlin by professors of the University during the holidays for schoolmasters and teachers. The course will include lectures on the X-rays by Prof. Goldstein, on the nervous system by Prof. Waldeyer, on metabolism by Prof. Zunz, etc.

WE learn from the *British Medical Journal* that a committee has been formed in Berlin for the celebration of the Jenner centenary on May 14th. Among the members are Prof. Virchow, Prof. R. Koch, Prof. von Leyden, Prof. von Bergmann, Prof. Gerhard, Prof. König and others. The program includes an exhibition of portraits, medals, old and new instruments, writings, etc., bearing upon Jenner's great discovery, and also a festive gathering on the day itself, intended not only 'to honor the benefactor of the universe,' but to protest against the anti-vaccination agitation which is constantly going on.

THE Committee on Agriculture of the Massachusetts Legislature has not yet been able to come to an agreement in regard to the appropriation for the Gypsy Moth Commission. It is understood that four members of the committee favor an appropriation of $200,000, four $100,000 and three $50,000.

THE steam yatch *Blencathra* will carry an excursion party to the arctic regions next summer, visiting Iceland, Greenland and Hudson's Bay.

PROF. JAMES F. KEMP, Columbia University, has consented to become one of the editors of the *Zeitschrift fur Praktische Geologie*.

PROF. J. B. CUMMINGS, since 1856 professor of science in Westminster College, died on March 31st.

PROF. B. F. TWEED, from 1855 to 1864 professor of rhetoric and logic in Tuft's College, and later supervisor of schools in Boston, died on April 2d, at the age of eighty-five.

THE anatomist, Dr. P. C. Sappey, died on March 14th, at the age of 86. He was the author of important researches on the respiratory apparatus of birds, on the lymphatics and on other subjects, but is best known for his great work on 'Descriptive Anatomy,' which was begun in 1847 and completed in 1863.

HAVING completed his report on the asphalts and other mineral resources of the Uncompahgre Indian Reservation and vicinity in Utah, based on investigations made last fall at the instance of the Secretary of the Interior, Mr. Geo. H. Eldridge, of the U. S. Geological Survey, has resumed geologic work in Florida and neighboring States, with reference more especially to the phosphate deposits of the region.

THE fourth fascicle of Messrs. Collins, Holden and Setchell's Phycotheca Boreali-Americana, has recently been issued, containing Nos. 151 to 200 of this valuable distribution of North American algæ. It is rich in species of the genus *Batrachospermum.*

Nature states that a number of admirers of Prof. Mittag-Leffler, the founder of the *Acta Mathematica,* will shortly present him with a congratulatory address, written in four languages—German, French, Italian and English—and expressing the appreciation of mathematicians of the services he has rendered to their science. It is proposed to present him at the same time with his portrait in oils, and a subscription list has been opened to obtain funds for that purpose. Prof. Appell, 6 rue Le Verrier, Paris, will be glad to receive subscriptions.

PROF. PUTMAN states in the *Harvard Graduates' Magazine* the Peabody Museum has received from the American Antiquarian Society many important archæological and ethnological specimens, among which may be mentioned the bow of a Massachusetts Indian. This bow was taken from an Indian in Sudbury in 1665, and is, so far as can be ascertained, the only authentic Massachusetts Indian bow now extant.

SOME interesting instances of human longevity have been brought to notice of late. Alexander Freeman, now at the Sailor's Snug Harbor, on Staten Island, was born December 22, 1786, and is now 110 years of age. In the Society of the War of 1812 are enrolled 33 veterans of that war, whose average age is ninety-nine years. Fourteen are more than one hundred. William Haines, who fought with the Tennessee militia at the battle of New Orleans, at the age of twenty-six, is still living at the St. Louis Memorial Home, aged 107. Davis Parks, aged 106 years, two months, is at Fowler, Mich. Percy Dyer, 104 years, 3 months, at Belvidere, Ill. Andrew F. McKee, 104 years, at Burlington, Kansas. Four years ago there were 65 names on the veteran list.

IN 'Little Africa,' a suburb of Mobile, Ala., still live a number of native Dahomians, brought over in April, 1859, in the last cargo of slaves imported from Africa. They retain many of the traditions and customs of their native land.

IN the Sunday edition of the New York *Sun* for March 29th Mr. Jeremiah Curtin, formerly of the Bureau of Ethnology, began a series of articles on primitive folk lore collected from the Indians in California, Mexico and Guatemala. He writes first on the traditions of the Uintas, a nation formerly resident on the right bank of the Sacramento from San Francisco Bay to the foot of Mt. Shasta.

THE *Revue Scientifique*, commenting on the proposal for the appointment of a permanent director of scientific work in the United States Department of Agriculture, remarks: "Nous comprenons le désir des personnes éclairées et bien intentionnées qui mettent en avant ce projet, et nous l'approuvons sans réserves; mais nous avons des doutes sur l'issue finale des événements, et ne croyons guère à la prochaine réalisation du pays d'Utopie rêvé par Morus."

ANOTHER chapter is added to our knowledge of quadrivalent lead, by Hutchinson and Pollard, in the March Journal of the Chemical Society. They have re-examined the crystals which form when red lead is dissolved in acetic acid and find their composition to be $Pb(C_2H_3O_2)_4$ lead tetracetate. The molecular weight obtained by freezing point and boiling point methods agreed with this formula as closely as is usual with the acetates. Water at once decomposes the salt quantitatively into lead dioxid and acetic acid, with hydrochloric acid the unstable lead tetrachlorid is formed, which in the presence of sal ammoniac is precipitated as ammonium plumbi-chlorid, $(NH_4)_2\,PbCl_6$. Lead tetrapropionate is also described. The authors point out the close resemblance of the quadrivalent lead salts to the stannic compounds, and urge the use of the name plumbic oxid in preference to lead peroxid. (It may be questioned if, after all, the widely used name lead dioxid is not preferable to either.) H.

As already announced in this journal, two expeditions will be sent from the United States to Japan to observe the total solar eclipse. The expedition from the Lick Observatory will be under the charge of Prof. Schaeberle, who will be accompanied by Dr. Charles Burckhalter, director of the Shabot Observatory, in Oakland, and Messrs. G. E. Shuez and Louis C.

Másten. The work will be wholly photographic in character. Prof. David P. Todd, who has charge of the Amherst expedition, has already left New York with a party consisting of Mr. and Mrs. Arthur Curtis James, of New York; Mrs. D. Todd, Chief Engineer John Pemberton, U. S. N., who goes with the permission of the Secretary of the Navy; Prof. William P. Gerrish, of Harvard, meteorologist and photographer; E. A. Thompson, of Amherst, the head mechanician, and Dr. Vanderpoel Adriance and Arthur W. Frances, of New York. The party will join the yacht 'Coronet' at San Francisco and will sail to Japan by way of Honolulu. The yatch carries a large number of instruments.

AT a postponed hearing on Vivisection before the House Committee of Judiciary of Massachusetts, the proposed legislation against vivisection was opposed by Profs. Bowditch, Theobald Smith and J. J. Putnam, of Harvard University; Prof. Hodge, of Clark University; Prof. Wilcox, of Wellesley College; Prof. Sedgwick, of the Massachusetts Institute of Technology, and others. President Eliot is reported by the Boston *Transcript* to have said that in the last twenty-five years, during which experiments in physiology had been conducted in Harvard, not a single instance of a student bringing any complaint of cruelty against the work done in the physiological laboratories had ever come to the knowledge of the corporation. There was no abuse of vivisection in Massachusetts. The men whom this bill indirectly accused of cruelty to animals were the most humane, merciful, clear-seeing men in the community, devoted, year after year, to the most humane occupation now existing in the world. Their profession showed in their faces, and he appealed to the members of the committee to know whether they thought that the men who had appeared before them could be guilty of the charge implied by the application for such legislation.

IN the first essay in his studies in the Theory of Descent, first published in 1875, Weismann discussed seasonal dimorphism in butterflies on the basis of direct experimentation and concluded that "differences of specific value can originate through the direct action of external conditions of life only;" and that "a periodically recurring change of climate is alone sufficient, in the course of a long period of time, to admit of new species arising from one another." In a recent essay on the same subject (*Neue Versuche zum Saison-Dimorphismus der Schmetterlinge*; Fischer, Jena, 1895), the details are given of fresh experiments and the whole subject is discussed anew with special reference to his constantly expanding views on the 'continuity of the germ-plasm.' The experiments are interesting and carefully recorded, but no theoretical conclusions varying much from those formerly reached are given, except in the distinction he makes between direct seasonal dimorphism and that which is adaptive, when the changes in temperature serve only to open the way to the action of natural selection.

THE third paper in Vol. VIII. of the Bulletin of the American Museum of Natural History is by Dr. J. A. Allen on *Alleged Changes of Color in the Feathers of Birds without Molting*, and is a careful review of the literature on the subject. Dr. Allen makes it plain that much of the so-called 'evidence' of change of color without molt is due to careless examination of specimens, much to a wrong interpretation of facts, and that much is pure assertion without any foundation whatever. Considerable alteration in plumage is brought about by the wearing away of the edges of feathers, slight changes result from bleaching, but while there may be a slight basis in fact for some of the speculations regarding change of color without molt, the cause, in nine cases out of ten, is demonstrably due to molt. 'Intermediate stages' are caused by the fact that a given molt does not affect all individuals of a species alike, but, owing to conditions of food, health, etc., some birds are carried to a more advanced stage than others.

AMONG the lectures to be given at the Royal Institution after Easter are the following: Prof. James Sully, of University College, London, three lectures on 'Child-study and Education;' Mr. C. Vernon Boys, three lectures on 'Ripples in Air and on Water;' Prof. T. G. Bonney, two lectures on 'The Building and Sculpture of Western Europe' (the Tyndall lectures); Prof. Dewar, three lectures on 'Recent Chemical

Progress;' Mr. W. Gowland, three lectures on 'The Art of Working Metals in Japan;' Dr. Robert Munro, two lectures on 'Lake Dwellings;' Mr. E. A. Wallis Budge, of the British Museum, two lectures on 'The Moral and Religious Literature of Ancient Egypt.' The first lecture of the Friday evening course will be by M. G. Lippmann, on 'Color Photography.'

WE learn from the London *Times* that the report of the Meteorological Council for the year ending March 31, 1895, submitted to the President and Council of the Royal Society, has just been issued as a Parliamentary paper. Of the forecasts issued at 8:30 p. m., in the year 1894–1895, the percentage of complete success was 56, of partial success 27, of partial failure 12, and of total failure 6. The average for the ten years from 1885 to 1894 was 51·2 of complete success and 30·7 of partial success. The storm warnings show a percentage of 68·5 of success and 23·5 of partial success. The warnings not justified by subsequent weather were 6 per cent. These figures show a marked improvement on those for the years from 1885 to 1893 inclusive. The hay harvest forecasts show a total percentage of 89 of complete or partial success. The Council express their regret that the experiment of exhibiting, at telegraphic stations in rural districts every afternoon, the daily weather forecasts is not to be repeated. The net expenditure of the Council in 1894–95 was £15,212 0s. 11d., as compared with £15,969, 7s. 6d. in 1893–94. The sum of £1,528 0s. 10d., was paid to the postoffice for services rendered. The income of the Council was £15,300, granted by Parliament, and £721 19s. 6d., received from various other sources.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. ELIZABETH MARY LUDLOW, the mother of the late Robert Center, has given his estate, valued at $150,000, to Columbia University for the purpose of endowing the 'Robert Center Fund for Instruction of Music.'

THE Teachers' College, New York, has received from a donor whose name is at present withheld, a gift of $250,000 to complete the present group of buildings. This will make the value of the property on Morningside Heights, adjacent to the grounds of Columbia University, about $1,000,000, and will add greatly to the facilities of the College and of Columbia University, to which it is affiliated.

MR. W. C. MCDONALD, whose gift of $500,000 to McGill University was reported in this journal last week has now given, in addition, $150,000, to be used in maintaining the engineering and physics building.

THE annual report of President Dwight, of Yale University, for the year 1895, states that gifts to the University during the year have amounted to $305,301.

THE Senate of Deans of the Catholic University of Washington has decided to establish an Institute of Technology. It is proposed to construct a special building for the purpose.

THE following instructors have been appointed in Harvard University: Charles Montague Bakewell, A. M., in philosophy; James Edwin Lough, A. M., in experimental psychology; Charles Palache, Ph. D., in mineralogy; Robert Jay Forsythe, A. B., in metallurgy and metallurgical chemistry.

BARON EÖTVÖS has been made full professor of experimental physics in the University at Buda-Pesth.

DISCUSSION AND CORRESPONDENCE.

HEREDITY AND INSTINCT (II.)*

IN the earlier paper I argued from certain psychological truths for the position that two general principles recently urged by Romanes for the Lamarckian, or 'inherited habit,' view of the origin of instinct do not really support that doctrine. These two principles are those cited by Romanes under the phrases respectively 'co-adaptation' and 'selective value.' In the case of complex instincts these two arguments really amount to one, *i. e.*, as long as we are talking about the *origin* of instinct. And the one argument is this: that partial co-adaptations in the direction of an instinct are not of selective value; hence instinct could not have arisen by gradual

*Conclusion of paper of same title in SCIENCE March 20th.

partial co-adaptive variations, but must have been acquired by intelligence and then inherited. This general position is dealt with in the earlier article.

It will be remembered, however, that the force of the refutation of the Neo-Lamarckian argument on this point depends on the assumption, made in common with him, that some degree of intelligence or imitative faculty is present before the completion of the instinct in question. To deny this is, of course, to deny the contention that instinct is 'lapsed intelligence,' or 'inherited habit.' To assume it, however, opens the way for certain farther questions, which I may now take up briefly, citing Romanes by preference as before.

I. The argument from 'selective value' has a further and very interesting application by Romanes. He uses the very fact upon which the argument in my earlier paper was based to get more support for the inheritance of habits. The fact is this, that intelligence may perform the *same acts* that instinct does. So granting, he argues, that the intelligent performance of these acts comes first in the species' history, this intelligent performance of the actions serves all the purposes of utility which are claimed for the instinctive doing of the same actions. If this be true, then variations which would secure the instinctive performance of these actions do not have selective value. and so the species would not acquire them by the operation of natural selection. By the Lamarckian theory, however, he concludes, the habits of intelligent action give rise to instincts for the performance of the same actions which are already intelligently performed, the two kinds of function existing side by side in the same creature.*

This is an ingenious turn, and raises new questions of fact. Several things come to mind in the way of comment.

First. It rests evidently on the state of things required by my earlier argument against the Neo-Lamarckian claim that co-adaptation could not have been gradually acquired by variation; the state of things which shows the intelligence preventing the 'incidence of natural selection' by supplementing partial co-adaptation. Romanes now assumes that intelligence prevents the operation of natural selection on further variations, and so rules out the origin of instinct through that agency, or, put differently, that actions which are of selective value when performed intelligently are not of selective value when performed also instinctively. But this seems in a measure to contradict the argument which is based on co-adaptations (examined in the earlier paper), *i. e.*, that instincts could not have arisen by way of partial co-adaptations at all. In other words, the argument from 'co-adaptation' asserts that the partial co-adaptations are not preserved, being useless; that from selective value asserts that they are preserved and, with the intelligence thrown in, are so useful as to be of selective value. We have seen that the latter position is probably the true one; but that the inheritance of acquired characters is then made unnecessary.

Second. Assuming the existence side by side in the same creature of the ability to do intelligently certain things that he also does instinctively, it is extraordinary that Romanes should then say that the instinctive reflexes have no utility additional to that of the intelligent performance. On the contrary, the two sorts of performance of the same action are of very different and each of extreme utility. Reflex actions are quicker, more direct, less variable, less subject to inhibition, more deep-seated organically, and so less liable to derangement. Intelligent actions—the same actions say—are, besides the points of opposition indicated, and by reason of them, more adaptable. Then there is the remarkable difference that intelligent actions are centrally stimulated, while reflex actions are peripherally stimulated. I cannot go into all these differences here; but the case may be made strong enough by citing certain divergencies between the two sorts of performance, with illustrations which show their separate utilities.

1. Reflex and instinctive actions are less subject to derangement. Emotion, injury, temporary ailment, hesitation, aboulia, lack of information, etc., may paralyze the intelligence; but instinct and reflex action may keep the creature alive in the mean time. What keeps dogs alive after extended ablations of the brain cortex?

*Op. cit., pp. 74–81.

2. Reflexes are quicker. Suppose instead of winking reflexly when a foreign body approaches the eye, I waited to see whether it was near enough to be dangerous, or even shut my eye as quickly as I could, I should join the ranks of the blind in short order.

3. Reflex actions are more deep-seated and arose genetically first. What keeps the infant alive and in touch with his environment before the voluntary fibers are developed? This genetic utility alone would seem critical enough to justify most of the genuine reflexes of the organism—supplemented, of course, by the mother!

4. Intelligent actions are centrally stimulated. This means that brain processes release the energy which goes out in movement, and that something earlier must stimulate the brain processes. This something is association in some shape between present stimulating agencies in the environment and memories, or pleasures and pains. In other words, certain central processes intervene between the outside stimulus and the release of the energies of movement. In reflexes, however, no such central influence intervenes. The stimulus in the environment passes directly—is reflected—into the motor apparatus. Hence the reflex is more direct, undeviating, invariable, sure. For example, research has recently proved that involuntary movements may be produced in a variety of normal circumstances, and in hysterical subjects, when the stimulation is too weak, or intermittent, or unimportant, to be perceived at all.

5. Experiments show that the energies of the two are not quantitatively the same. Mosso and Waller have shown that the muscles may work under direct stimulation after being quite exhausted for voluntary action, and *vice versa*. They may be exchanges of energy between the two circuits involved, which give the animal increased force in this reaction or that.

6. The intelligence could not attend to the necessary functions of life without the aid of reflexes, to say nothing of the luxuries of acquisition. So not to get the reflexes would prevent the growth of the intelligence. For example, suppose we had to walk, wink, breathe, swallow, scare away flies and mosquitoes, etc., all by voluntary attention to the details and all at the same time. While chasing flies we should forget to breathe! And when should we have a moment's time to think? In this line it is in order to cite the experiments made on 'distraction,' which show that most of the common adaptations of life can go on by reflex and sub-conscious processes while the intelligence is otherwise occupied.*

7. Attention and voluntary intermeddling with reflex and instinctive functions tends to destroy their efficiency, bringing confusion and all kinds of disturbance.

These are all simple psychological facts, and more might be added showing that instinct has its own great utility even when the intelligence may perform the same actions in its own fashion. So it remains in each case to find out this utility and measure it, before we say that it is not of selective value. I should say that reflexes are generally of supreme importance and value; and if so, then natural selection may be appealed to to account for them. So, about all that remains of this argument of Romanes is the contribution which it makes to the refutation of his other one, from co-adaptations. The assumption of intelligence disposes of both the arguments, for the intelligence supplements slight co-adaptations and so gives them selective value; but it does not keep them from getting farther selective value as instincts, reflexes, etc., by farther variation.

II. But there is another very interesting question also to be settled by fact. Romanes and others cite simple reflexes as well as complex instincts as giving illustrations of the application of the principle of 'inherited habit' or 'lapsed intelligence;' and the cases which Romanes lays great stress on are the reflex actions of man's withdrawal of the leg from irritation to the soles, and the brainless frog's balancing himself.† The Neo-Lamarckian theory requires the assumption of intelligence for all of these. I have shown that granting the intelligence, that is just the assumption which in many cases enables us to discard the Lamarckian factor. But we may ask, is the assumption itself necessary for all reflexes?

*See Binet, *Alterations of Personality*, Part II., ch. 5. (Eng. trans. announced by Appletons.)

† Passage cited.

The question is too involved for treatment here; but the assumption that intelligence is necessary in any sense which make the *conscious voluntary* performance of the action always precede the reflex performance of it is very difficult to defend. For all that we know of the brain seat of voluntary intelligence, of the use of means to ends, etc., makes such action dependent in its origin upon the presence of the great mass of organic reflex processes which go on below the cortex. Complex associative processes must be genetically (and phylogenetically) later than the simple reflex processes, which, as has been intimated above, they presuppose.

But the more liberal definition of intelligence, which makes it include all kinds of conscious processes—the assumption of intelligence being the assumption of conscious process of some kind—that is a different matter. This supposition seems to be necessary on either theory of instinct, as I have argued;* for if we do not assume it, then natural selection is inadequate, as say Romanes and Cope; but if we do assume it, then the inheritance of acquired characters is unnecessary. On this simpler definition of intelligence, however, we find certain simpler states of consciousness, of which imitation is the most prominent example, serving nature a turn in the matter of development.

And on this wider view of intelligence the difference between intelligent (*i. e.*, imitative) action and instinctive reflex action is much greater than that pointed out in detail above between voluntary and reflex action. A word to show this may be allowed me, since it makes yet stronger the case against the special argument from selective fitness, which this paper set out to examine.

The differences between imitative action and reflex or instinctive action are not just those which we have found between voluntary and reflex actions. Imitation seems to be in a sense instinctive; and in the animals it seems to be, like the instincts, peripherally initiated. But it has a farther point of differentiation from the special instincts and reflexes, in that it is what has been called a 'circular' reaction, *i. e.*, it tends to reproduce the stimulus again — the movement seen, the sound heard, etc. There is always a certain comparability or similarity, in a case of conscious imitation, between the thing imitated and the imitator's result; and the imitation is unmistakably such in proportion as this similarity is real. We may say, therefore, that consciously imitative actions are confined to those certain channels of discharge with produce results comparable with the 'copy' which is imitated.

But the special instincts and reflexes are not so. They show the greatest variety of arrangement between the stimulus and the movement which results from it—arrangements which have grown up under the law of utility. They represent therefore special utilities which direct conscious imitation in each case, by the individual creature, could not secure; while conscious imitation represents a general utility more akin to that which we have seen the voluntary intelligence subserving.

If this be so, then we have to say that conscious imitation, while it prevents the incidence of natural selection, as has been seen, and so keeps alive the creatures which have no instincts for the performance of the actions required, nevertheless does not subserve the utilities which the special instincts do, nor prevent them from having the selective value of which Romanes speaks. Accordingly, on the more general definition of intelligence, which includes in it all conscious imitation, use of maternal instruction, and that sort of thing (the vehicle of 'social heredity')—no less than on the more special definition spoken of above—we still find the principal of natural selection operative and adequate, possibly, to the production of instincts and reflexes.*

J. MARK BALDWIN.

PRINCETON, March 17, 1896.

*See my article 'Consciousness and Evolution,' examining some parts of Prof. Cope's position, in SCIENCE, August 23, '95, reprinted kindly by him in the *American Naturalist*, March, '96, with reply in the succeeding issue of the latter journal.

*This and the two preceding papers in this journal are not intended as more than preliminary statements of results thrown into the form of criticisms of particular views (*i. e.*, Romanes' and Prof. Cope's). For this reason I have not brought in reference to the general literature of the subject.

THE X-RAYS.

TO THE EDITOR OF SCIENCE: As opportunity offered experiments have been made in our laboratory with the X-rays since a few days after the appearance of Prof. Röntgen's paper. Of course, we have repeated most of the experiments that have been announced from trustworthy sources; but I recall one or two observations made here that I have not seen notice of, and take the liberty of offering the account to your journal. I use a Ruhmkorff coil with Foucault interrupter. About two ampères from accumulators, through the primary gives about six-inch spark in the secondary. For a tube I have used one of my old Crookes tubes. The one I have found to work best is pear-shaped, nine inches long, four inches in diameter at the larger end, with a flat disc cathode in the small end, set with the plane of the disc perpendicular to the length of the tube, and for anode it has a Maltese cross inserted about the middle. The cross is hinged so that it may be shaken down and thus not obstruct the cathode radiation. The tube is the one designed, in Crookes set, to show that the cathode radiation is in straight lines and will 'cast a shadow.' The first plate I exposed was with this tube, the cross of the anode being up so as to cast a shadow in the end of the tube. The plate being close to the tube, a clear shadow of the anode was cast upon it. On repeating the experiment with the sensitive plate six inches distant, there was no image of the cross on the plate, which was, instead, densely 'light struck' all over. This adds another to the quite numerous proofs that the X-rays originate at the phosphorescent surface of the glass and not at the cathode. The second observation I wish to notice is a perfectly simple and commonplace method of getting a sharp clear image by these X-rays, which refuse to be reflected or refracted. It is the use of a metal diaphragm interposed between the tube and the sensitive plate. I have found a metal plate with a circular hole one inch in diameter, placed half an inch from the tube, the tube being six inches from the sensitive plate to give very satisfactory results.*

The most interesting observation is a physiological effect of the X-rays. A month ago we were asked to undertake the location of a bullet in the head of a child that had been accidentally shot. On the 29th of February Dr. Wm. L. Dudley and I decided to make a preliminary test of photographing through the head with our rather weak apparatus before undertaking the surgical case. Accordingly Dr. Dudley, with his characteristic devotion to the cause of science, lent himself to the experiment. A plateholder containing the sensitive plate was tied to one side of his head, with a coin between the plate and his head, and the tube was set playing on the opposite side of his head. The tube was about one-half inch distant from his hair, and the exposure was one hour. The plate developed nothing; but yesterday, 21 days after the experiment, all the hair came out over the space under the X-ray discharge. The spot is now perfectly bald, being two inches in diameter. This is the size of the X-ray field close to this tube. We, and especially Dr. Dudley, shall watch with interest the ultimate effect. The skin looks perfectly healthy, and there has been no pain nor other indication of disorder. I called attention to the place before Dr. Dudley had himself noticed it, and we were both for some time at a loss to account for it, as we had no previous intimation of any effect whatever.

But this little incident may bear a suggestion. The X-rays are as yet unexplained; but the suggestion, beginning with Prof. Röntgen himself, has more than once been made that they are longitudinal rather than transverse vibrations. It is difficult to distinguish a longitudinal displacement of the ether from an electric current, as far as it goes. It is a well-known method of exterminating hair, that of sending a current to its roots by a needle. If any such quasi electric current has resulted from the X-rays the effect upon the hair might be thus accounted for. The intensity of the discharge was not sufficient to heat the tube except very

*I enclose two prints, one of a hand and one of a part of the forearm, showing the effect of a gunshot wound made thirty years ago. The print shows how the ulna, some inches of which was shot away, has attached to the radius, and also shows some half a dozen shot still in the arm. It would have been difficult to get such clear shadowgraphs of objects so large as these without a diaphragm.

slightly; and the occasional small electrostatic spark from the surface of the tube to the hair, but which was hardly noticeable, will also not account for this effect. JOHN DANIEL.

PHYSICAL LABORATORY,
VANDERBILT UNIVERSITY, March 23, 1896.

INSTINCT.

TO THE EDITOR OF SCIENCE: Having read with considerable interest the discussions under *Instinct*, and having noticed the different opinions expressed concerning the eating and drinking of the chick, I thought that perhaps my personal experiments in regard to the matter might be of interest.

About eight years ago I was desirous of studying the chick before and after hatching, and for this purpose I placed about three hundred eggs in an incubator. I shall confine myself to those that were allowed to hatch.

Those that hatched were divided into two groups, an unhealthy and a healthy group. Those in the first group were fed and given water until they became strong enough to care for themselves. Those in the second group had food and water placed so that they could get them, but they were not fed nor given water, nor were they taught how to secure food and water. No tapping on the dish or on the floor, and no putting of the bill in the food or water was practiced. They were left entirely to themselves.

By watching these chicks, I noticed that they would occasionally run over their food and water, and frequently they stumbled in them. If the beak became wet, up would go the head, and the water was swallowed. If food adhered to the beak, some would get on the tongue, and it would be swallowed. In time they seemed to recognize that the food and water were palatable by repeatedly stumbling in them and getting them on the beak, and finally they *learned* how to secure them, *i. e.*, how to pick them up. I noticed that at first they did not know how to pick up, but, after repeatedly trying, they learned how. The majority of these chicks lived and developed.

Now if we consider the attempt to pick up, from observation I conclude that it was by *instinct*; but if we consider the picking up, I conclude that it was an *acquired* characteristic.

In conclusion, I might say that at the end of the third day all of the chicks—about fifty— instinctively attempted to pick up, and that at the end of the fifth day they were able to pick up and place the food or water so that it could be swallowed. J. C. HARTZELL, JR.

ORANGEBURG, S. C., March 25, 1896.

VISUALIZATION AND RETINAL IMAGE.

A STORY which has been going the rounds of the press about a successful attempt by Mr. Engles Rogers at photographing his own retinal image of a dead child, said image being produced by visualizing effort, induces me to suggest through SCIENCE that the subject is worthy of more thorough investigation than it has yet received. What effect also hallucination has upon the retina might be determined from study of insane patients dead from hallucinatory fright, etc. In some cases of sudden death by accident there seems to be evidence of a persistence of retinal image; and it seems highly desirable that hospital surgeons should have a simple instrument for investigating such cases. An image which should represent other scenes than the surroundings at time of death might be evidence for mere visualization effecting a retinal image. HIRAM M. STANLEY.

LAKE FOREST, ILL.

NAVAL EROSION.

TO THE EDITOR OF SCIENCE: An interesting locality for obtaining some measure of the interference of navigation with the normal geological cycle is the Kennebec River, in Maine. Several summers ago, chancing upon this river, I was struck with the completeness of the phenomena of erosion produced by our steamer in disturbing the water.

This stream is an estuary for nearly forty miles from its mouth. It has numerous islands and in many places steep banks. There is a vast amount of glacial material strewn along its shore which, with the matter brought down stream, has silted the river bottom completely. I noted all along the shore that the water in advance of the steamer rose slightly on the bank, but was immediately drawn back to fill the space just occupied by the boat. At some points this recession amounted to fifteen or twenty feet, and at no place was it less than two feet. I could hear a pronounced rattle as the material was dragged down the shore, and several boulders as big as hen's eggs were rolled three to four feet. Following the withdrawal of the water was a series of waves produced by the prow and sides of the boat. These waves, some of which were a foot high, occurred in sets of three, three more noticeable sets, followed by many smaller ones. They sorted material up to the size of a walnut.

In streams, such as this one, which form the paths of commerce for many cities, the erosion produced by the combined passage of craft of all kinds must be a not-inconsiderable factor.

G. W. Tower.

U. S. Geological Survey, Washington, D. C.

SCIENTIFIC LITERATURE.

The Polar Hares of Eastern North America, with Descriptions of New Forms. By Samuel N. Rhoads. Am. Naturalist, March, 1896, pp. 234–239.

The Polar Hare of North America was separated from that of Scandinavia by Leach as long ago as 1819, since which date its specific distinctness has been admitted by nearly all mammalogists. Still, Mr. Rhoads finds it necessary to reëstablish its claim to recognition, and also to drop the time-honored name *glacialis* conferred by the naturalist Leach, who described it, and to substitute therefor the name *arcticus*, under which it was mentioned by Capt. John Ross, commander of the expedition which brought back the specimen. Capt. Ross was not a naturalist and made no claim to technical knowledge of zoölogy, but in his report on the expedition he mentioned, under the heading 'Zoölogical Memoranda,' a number of mammals and birds. Among these the Polar Hare naturally found a place. His brief account of this animal begins with the words: 'Species *Lepus arcticus*, Leach,' from which it is to be inferred that Leach, who gave him the name, at that time intended to use it. Capt. Ross stated further: "Dr. Leach thinks it [the Polar Hare of Baffin Land] to be very distinct from the common White Hare of Scotland (*Lepus albus*, Brisson) and equally so from the *Lepus variabilis*, Pallas. See Appendix, No. V."—showing that all he knew of the animal came from Leach. Leach contributed to Capt. Ross' report a chapter entitled, 'Descriptions of the New Species of Animals Discovered by His Majesty's Ship Isabella in a Voyage to the Arctic Regions' (Vol. II., pp. 169–179). Leach's name *glacialis*, followed by a Latin diagnosis and English description, occurs on page 170, while the name *arcticus*, as published by Ross, is on page 151 of the same volume.

Briefly stated, the facts seem to be these: Leach, the naturalist, discovered that the American Polar Hare is different from the European and described it under the name *arcticus*, which name he changed before the report was printed, perhaps while it was passing through the press, to *glacialis*. Capt. Ross published the name and facts communicated to him by Leach, and the sequence of chapters gave him twenty pages priority. The question is, shall the name of a new species, given by a naturalist of repute and accompanied by a proper diagnosis, be set aside because an accident of sequence brings another name a few pages earlier in the same publication. This question Mr. Rhoads answers in the affirmative. The verdict of other naturalists on the same point is of interest. A hasty examination of the literature shows that ten persons have used the name *arcticus*, while thirty-six have used the name *glacialis*, as follows:

AUTHORS WHO MENTION THE AMERICAN POLAR HARE UNDER THE NAME ARCTICUS.

Ross, 1819	Trouessart, 1880
Gray, 1843, 1867	Coues, 1884
Gerrard, 1862	Murdoch, 1885
Fitzinger, 1867	True, 1887
Allen, 1875, 1877	Rhoads, 1896

AUTHORS WHO MENTION THE AMERICAN POLAR HARE UNDER THE NAME GLACIALIS.

Leach, 1819	Gray & Ray, 1850
Sabine, 1823	Audubon & Bachman, 1854
Jameson & Scoresby, 1823	Baird, 1857
Parry, 1824	Osborn, 1859
Richardson, 1825, 1829 1836, 1839	Bernard J. Ross, 1862
Harlan, 1825	Murray, 1866
J. C. Ross, 1825, 1826	Chenu, 1867
Godman, 1826	Brown, 1868, 1875
Lesson, 1827, 1842	Dall, 1870
Hamilton Smith, 1827	Allen, 1871

Fischer, 1829	Lilljeborg, 1874
Bachman, 1837, 1839	Gill, 1876
Schinz, 1844	Rink, 1877
Wagner, 1844	Feilden, 1878
Nilsson, 1847	Greely, 1888
Luben, 1848	Brauer, 1888
Waterhouse, 1848	Merriam, 1892

If there were no other reason for choosing *glacialis* instead of *arcticus*, and wholly irrespective of the merits of the two names, *glacialis* would have to be taken if we accept the rule that in cases of names of equal pertinency, the first reviser of the group has the privilege of fixing the name. *Lepus glacialis* was used without exception by all the naturalists who published on American rabbits between 1819 and 1843, including Richardson, Godman, Lesson, Hamilton Smith, Fischer and Bachman. It is obvious, therefore, that the name *glacialis* cannot be displaced unless one of earlier date be found.

Linnæus described the Arctic-Alpine Hare of the mountains of northern Europe, under the name *Lepus timidus*, in the 10th edition of his *Systema Naturæ* (1758, p. 57), and referred to his previous description in *Fauna Suecica* (1746, No. 19, p. 8), thus fixing Scandinavia, and presumably southern Sweden, as the type locality of the species. The common large hare of Europe, although often confused with *L. timidus*, is a distinct species and was named *L. europæus* by Pallas as early as 1778. The distinctness of the two was admitted by Nilsson, Lilljeborg and others, and is recognized by Lydekker, one of the most conservative mammalogists of the present day. Notwithstanding these facts, Mr. Rhoads takes the trouble to re-restrict the type locality of *timidus* to 'Southern Sweden,' and to re-affirm the distinctness of the American animal—a point conceded by nearly all mammalogists for three-quarters of a century.

Mr. Rhoads' next effort is to divide the American Polar Hare into additional species and sub-species, as follows: *L. arcticus* [= *L. glacialis* Leach] from Baffin Land, *L. arcticus bangsii* from Newfoundland; and *L. greenlandicus* from Greenland. Instead of contrasting these with one another, or with the original *Lepus glacialis* of Leach as a standard, he crosses the seas to make his comparison with *L. timidus*. Hence, if one aspires to know how the Newfoundland and Greenland Hares differ from the typical American animal from Baffin Land, he must first ascertain how each differs from the Scandinavian *timidus*, and then, by various processes of addition and subtraction, seek to find how they differ from one another. At this point he is likely to be overwhelmed with discouragement, for Mr. Rhoads does not always describe the same parts or structures in the forms he names as new. Thus, we are told that, in *L. timidus* "the radius of the arc described by the incisors is one-eighth ($\frac{12}{100}$) of the basilar length of the skull," and in *L. greenlandicus* the same radius 'is one-fifth ($\frac{20}{100}$) the basilar length,' but in *arcticus* and *bangsii* the arcs of the incisors are not described at all, leaving the student of the geometry of Leporine teeth in abject despair.

After a somewhat exhausting study of Mr. Rhoads' paper, the only tangible difference I am able to find between the Newfoundland and Baffin Land Hares is that the latter turns gray in summer, while the former turns only partly gray. This sets one to wondering if Mr. Rhoads will next separate weasels that turn white in winter from specimens of the same species that remain brown the year round.

At the close of his paper Mr. Rhoads states that he "is now preparing a more comprehensive revision, with illustrations, of the New World representatives of the *Lepus timidus* group." Let us earnestly hope that he will make it sufficiently comprehensive to tell how the component parts of the American Polar Hare differ from one another. C. H. M.

North American Birds. By H. NEHRLING. 4°, part XIII., pp. 47, pls. 2. March, 1896. Geo. Brumder, Milwaukee.

The 13th part of Nehrling's well-known work has just come to hand. It treats of the Cardinals, Rose-breasted and Blue Grosbeaks, Indigo, Lazuli and Painted Buntings, Grass-quits, the Dicksissel, Lark Bunting or White-winged Blackbird, and Bobolink. The text maintains the high standard of the earlier numbers, but the two colored plates, both of which are of the 'mixed' kind, are cheaply printed and decidedly inferior.

An unusually large proportion of the birds whose life histories make up the present part are species with which Mr. Nehrling is personally familiar; as a result most of the biographies are original and more than ordinarily interesting. Mr. Nehrling not only loves birds, but he has a keen ear for the harmonies of nature. "The Bobolink," he says, "never sings before sunrise. It begins its sweet music when the more earnest and solemn melody of the Robin, which was heard from earliest daybreak, is almost at its close. Nature seems to have ordained that the serious part of her musical entertainment in the morning hours should be heard first, and that the lively and merry strains should follow them. In the evening this order is reversed, and after the comedy is concluded nature lulls us to repose by the mellow notes of the Vesper Sparrow and the pensive and still more melodious strains of the solitary Thrush." C. H. M.

The Book of Antelopes. By P. L. SCLATER and OLDFIELD THOMAS. With colored plates by WOLF and SMIT. 4°. London, R. H. Porter, 1895–96.

Since the notice of parts I. and II. of this admirable work (SCIENCE, April 5, 1895, p. 389) the first volume has been completed and one part of the second has appeared. Vol. I. contains 220 pages and twenty-four handsomely colored plates, besides numerous useful figures in the text.

Parts III. and IV. treat of the duikers (genus *Cephalophus*), and part IV., which completes the first volume, closes with an account of the four-horned antelope (*Tetraceros quadricornis*). The duikers, unlike most of the antelopes, live in brush and forests. They inhabit Africa south of the Sahara, and most of the species are restricted to West Africa. Twenty species are recognized, ranging in size 'from that of a small donkey down to that of a hare.' As a rule they are handsomely colored, though most of them lack the striking and, in some cases, startling recognition markings that characterize some of the other groups. A few of the species, however, as the banded duiker (*C. doriæ*) and the yellow-backed duiker (*C. sylvicultrix*), are conspicuously marked.

Part V., comprising ninety-two pages and six colored plates, takes up the African subfamily Neotraginæ and treats of the klipspringer (*Oreotragus*), the oribis (*Ouretria*), the grysbok and steinboks (*Raphicerus*), the Zanzibar and Livingstone's antelopes (*Nesotragus*), the royal antelope (*Neotragus*) and the dik-diks (*Madoqua*).

The book of Antelopes is a timely work and it is matter for congratulation that the colored plates prepared under the supervision of the late Sir Victor Brook more than twenty years ago are finally given to the public accompanied by such authoritative letter press. If the distinguished authors have erred in the treatment of certain species it is on the side of conservatism, and it must be admitted that they have enjoyed unsurpassed opportunities for the study of the living animals at the Zoölogical Society's Gardens, of which the senior author has had charge for nearly forty years, and for the study of skins and skulls in the rich mammal collection of the British Museum, of which the junior author has long been curator.

Still, one is filled with regret at the large number of species unrepresented, or at most imperfectly represented, in museums, and it is sad to feel that many species are on the road to rapid extinction. Before it is too late sportsmen as well as naturalists should spare no pains to secure specimens of the rarer kinds and see that they reach some of the larger museums, where their permanent preservation will be guaranteed. C. H. M.

Chemistry for Engineers and Manufacturers. By BERTRAM BLOUNT, F. I. C., F. C. S. and A. G. BLOXAM, F. I. C., F. C. S. *Vol. I.—Chemistry of Engineering, Building and Metallurgy.* Philadelphia, J. B. Lippincott Co. London, Charles Griffin & Co., L't'd. 1896. 8vo, 244 pp., Illust. $3.50.

This is the first volume of a small and concise work on Chemical Technology, which is especially intended for engineers, architects, builders and factory superintendents, as well as students of chemical technology. It is intended primarily for those whose knowledge of chemical theories and processes is limited, but so skilfully is the subject-matter presented that even trained chemists and expert engineers may find the book helpful. All descriptions of processes and apparatus are necessarily much condensed, matters of detail being relegated to the larger handbooks and monographs on special subjects, which, in the opinion of the reviewer, is their proper place. But the addition of references to the larger and special works, either as footnotes or otherwise, would have materially increased the value of the book without altering its character as an elementary work.

The present volume consists of two parts, the first being devoted to a general introduction and Part II. to Metallurgy.

The four introductory chapters are each given to a special topic. Chapter I., 'The Chemistry of Materials of Construction,' treats of the properties of stone, brick and concrete, roofing materials, the structural metals, and the strength, permanency and preservation of these substances. Chapter II. deals with 'The Chemistry of the Sources of Energy,' viz.: solid, liquid and gaseous fuels, electrical heating, measurement of temperature, direct conversion of chemical into electrical energy and the natural forms of kinetic energy. 'The Chemistry of Steam Raising' is the title of the third chapter, which has for its subjects, water and the methods of purifying and softening it for use in boilers. 'The Chemistry of Lubricants and Lubrication' is briefly disposed of in some seven pages, forming the fourth chapter.

Part II., comprising about one-half of the book, is a fairly complete though condensed presentation of the subject of Metallurgy in all its branches. The commercially important metals, some nineteen in number, are here included, their chief ores described and the processes of their extraction set forth in a brief and readable manner. Many of the important appliances and parts of smelting and refining plants are illustrated by cuts. Numerous tables of analyses of ores and of finished products are scattered through the text. In these days of popular interest in mining and metallurgical schemes, it would seem that this section should lend the book an attraction to many persons in commercial life, though they may have little or no scientific education. The facts are so clearly and tersely stated and illustrations are so frequent that any one of average intellect, though not a chemist or engineer, should have no difficulty in understanding the work. Technical terms and chemical symbols are frequently used, it is true, but in the case of the latter the common names of the substances are also stated, hence no confusion need result.

But it is to the teacher of chemistry and metallurgy, having to deal with young students, where an elementary treatise, short and compact in its nature is desired, that this book will be most welcome. Here are found the essential facts without those mystifying details which often become magnified to undue proportions in the mind of the student.

A very complete index, free from mistakes or misprints, closes the volume.

If the second volume, covering the field of manufacturing chemistry, be as well done as this, a valuable addition will have been made to the mass of chemical literature.

FRANK H. THORP.

The Chemistry of Pottery. By KARL LANGENBECK. Easton, Pa., Chemical Publishing Co. 1896. 12 mo., pp. 197.

In this little book the author has collected and systematically arranged some of the results of an extended experience in the manufacture of pottery and tiles. The chemical bearing of each subject in its relation to the object desired is made the chief element of the work. Analyses of the materials are taken as the basis on which to calculate rational formulæ for the production of certain results.

The book is divided into fifteen chapters, each treating of a separate subject, a few of which may be mentioned. In Chapter I, Analysis of Materials and Products, and in Chapter II., Physical and Empirical Tests, are explained. The subject of Chapter III. is Pyrometry, a matter of great interest to the pottery maker, since the success of his work depends, in great measure, on the proper heat in his furnace. Estimation of the temperature becomes a matter of experience with the burner, who often acquires much skill in producing some one kind of ware in a given furnace. But if called upon to burn other ware than that to which he is accustomed, or to use different fuel, or a kiln of different construction, failure may be the result. The author recommends the use of the 'Normal Pyrometric Cones,' invented by Dr. Seger, as affording a safe and simple method of controlling the temperature of the kiln. He considers it quite possible to prepare cones from our domestic materials, fully as reliable as those now made in Germany.

In Chapter V. that subject often so troublesome to pottery makers—Glazes, their requirements and composition—is presented. The various kinds of Ware, Bricks and Terra Cotta comprise the succeeding chapters up to the fourteenth, on Refractory Materials, in which the preparation of fire clays for use in kiln building and for "saggars," is fully explained. Sixteen pages on Burning the Ware, in which the requisites of this important part of pottery making are interestingly detailed, form the final chapter. A convenient index follows.

A few more illustrations or diagrams in the body of the work would have given it added interest for the majority of chemists who have only a superficial knowledge of the processes of pottery making. FRANK H. THORP.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, FEBRUARY–MARCH.

Kame Areas in Western New York South of Irondequoit and Sodus Bays: By H. L. FAIRCHILD. The purpose of the paper is to describe certain massive deposits of sand and gravel apparently formed by the glacial drainage. These bays are the extreme points in the great landward curve in the south shore of Lake Ontario, and are thought to have greatly influenced the drainage of the region during the recession of the ice. Four Kame areas are described—Irondequoit, Victor, Mendon and Junius. The author finds these areas alike in the following particulars: (a) they are located in the basin of Lake Warren; (b) they have an overwash or silt plain to the southward; (c) they lie in the midst of drumloid ridges which antedate the kame deposits; (d) only one has any clear connection with an extended frontal moraine. He thinks the causation is complex, including rapid ice retreat, action of lake waters to prevent great local accumulations of morainic till and heavy glacial drainage.

A Pre-Tertiary Nepheline-Bearing Rock: By F. BASCOM. The rock in question is a glacial boulder found in the vicinity of Columbus, Ohio. There was a single specimen about a foot and one-half in diameter, but it is of a type so rare as to justify in the mind of the author a particular mention. She inclines to the opinion that it belongs to the nepheline syenite porphyry group. The source is not known, but is presumed to be the area north of Lake Huron, and if so the boulder is from a Cambrian horizon or lower. In any case it is a pre-Tertiary dike or surface volcanic resembling the modern type.

Remarks on Petalodus Alleghaniensis (Leidy): By CHAS. R. EASTMAN. In a previous issue of the journal Dr. Hay described a specimen of Selachian tooth from the Carboniferous of Illinois. For the form he proposed the name Petalodus Securiger. In the present paper the author dissents from this view and gives reasons why the new name should not be accepted. His opinion is that the form belongs to P. Alleghaniensis.

Patalocrinus Mirabilis (N. sp.) *and a New American Fauna:* By S. WELLER and MRS. A. D. DAVIDSON. The fossils here described were collected by the junior author in Jones county, Iowa. Goniophyllum pyramidale and the species of Crotalocrinus have long been known in the Gothland limestone of Sweden. In this Iowa Silurian fauna, species of Goniophyllum are found indistinguishable from those of Gothland, with a crinoid whose nearest ally is Crotalocrinus. The crinoid, which is a new one, is carefully described and figured by the senior author, who finds an explanation of the similarity between the Gothland and Iowa faunas in a migration along a supposed shore line, joining the east American and British regions during Niagara time.

On the Nature of Igneous Intrusions: By ISRAEL C. RUSSELL. In a previous paper the author described some hills in the Black Hills region, which illustrated a little known phase of igneous intrusion. He now discusses igneous intrusion in the light of his large experience in many localities. Of these he finds several classes—intruded sheets like those of the Newark which, when widely extended are of easily fusible rock and relatively surperficial, laccolites like the well-known Henry mountains, plutonic plugs of which there are several examples in the vicinity of the Black Hills, and deeply-seated intrusions of a viscous magma which raised vast domes of sedimentary rock with the floor of metamorphic rock on which they rested as the whole Black Hills dome, Big Horn and Park mountains. As to the cause of these uplifts, nothing less than the force exerted by a cooling globe is thought to be adequate. That they took place very slowly is inferred from the fact that fracture did not result from the bending of thousands of feet of strata. That these domes are in the interior of the continent rather than near the coast is because here the crust is relatively light and strata are horizontal, hence pressure on the plastic interior due to contraction of crust or to transfer of material on the surface would be most likely to produce domes.

Deformation of Rocks: By C. R. VAN HISE. This is the first of a series of papers on the same subject to be published in the *Journal* as 'Studies for Students.' The author divides the outer part of the earth into three zones: (1) An upper zone of fracture; (2) a middle zone of fracture and plasticity; (3) a lower zone of plasticity. Rocks under less weight than their ultimate strength when rapidly deformed are in the zone of fracture. The maximum depth at which fracture can take place is thought to be 10,000 meters. Rocks below this are in the region of plasticity and flowage. Since flowage is necessary to folding, closely folded strata were generally buried beneath other strata. The boundary between the zone of fracture and that of flowage is at different depths for two rocks of different strength, also for the same rock under different conditions of stress, hence there is a zone of combined fracture and flowage. This is thick and of prime importance. In heterogeneous strata in this zone, irregular fracturing, brecciation, jointing, faulting, folding, and development of secondary structures, may occur together in a most complex manner. Between the three zones there are many gradations.

Chas. R. Keyes contributes a careful and appreciative review of Wachsmuth and Springer's new book, *North American Fossil Crinoidea Camerata.* Several reviews and authors' abstracts of current geological literature follow.

SOCIETIES AND ACADEMIES.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, MARCH 10, 1896.

An elementary presentation of the tides: BY W. M. DAVIS.

The object of this communication is to show how the tides may be treated in an essentially scientific manner in an elementary collegiate course on physiography. The facts are presented by means of tracings from selected automatic records of tide gauges in the Coast Survey office, for stations in mid-ocean (Honolulu), Pacific coast (Port Townsend, Wash.), Atlantic coast (Boston), and in estuaries (Delaware at Philadelphia, and lower Seine, the latter from French records). Mean interval of tides, and systematic variation of interval and of range are numerically determined from these records by the students in laboratory exercises. The agreement of the mean interval with half a lunar day suggests that the moon and the tides may be related in some way as cause and effect. Inquiry is then made as to the manner in which the moon could cause periodic oscillations of the ocean.

The dimensions, distance and movements of the earth and moon being given, the deforming forces due to lunar attraction, situated as it were on a shell enclosing the earth, are worked out quantitatively in terms of gravity, according to the law of gravitation. A tide opposite to the direct lunar tide, often regarded as an obscure part of the problem, is seen to be as essential a consequence of the theory as the direct tide itself. The first simple supposition of a moon moving in a circular orbit in the plane of the earth's equator is afterwards changed to the actual condition of the moon moving in an orbit of considerable eccentricity and in a plane oblique to the equator; thus introducing expectations of various systematic inequalities in tidal intervals and ranges. The essential features of diurnal inequality are simply illustrated as a necessary consequence of theory by means of a 'tidal globe,' rigged with appropriate circles for high and low tides. Solar tidal forces and their combinations with lunar forces are easily calculated to a sufficient degree of detail.

Although the forces available for the deformation of the ocean are so small that the student may at first doubt their sufficiency as a cause of the observed tides, his doubts vanish when the consequences of the theory are systematically confronted with the generalized results of observation, and the extraordinary agreements of the two are discovered. Although a fairly complete record of facts may be made by the average college student in the early laboratory exercises, it is nearly always the case that some classes of facts will escape his first scrutiny of the tidal curves and will be revealed only when attention is called to them by the expectations of theory. Due attention is thus paid to the different kinds of verification of theory. The final acceptance of the theory becomes a logical necessity, independent of the will, even though certain features of the tides, especially of the Atlantic tides, remain beyond the reach of the elementary discussion here attempted.

The treatment of the open-ocean tide and the onshore tide, as comparable to offshore swell and on-shore surf, suffices to explain various facts as to age and range; and the treatment of the on-shore tide as a wave accounts for the peculiar relations often observed between flood and ebb currents and high and low water. It is on the basis of work of this kind that the claim is made of the essentially scientific quality of physiography. Although other divisions of the subject may not be dealt with mathematically, they all contain the logically successive phases of observed and generalized facts, postulated general principles, provisional hypotheses, consequences or expectations deduced from the hypotheses, comparison of the consequences with the facts, and final evaluation of the knowledge gained. Lunar gravity is the main force causing the tidal changes of the sea; terrestrial gravity is the main force causing the slower physiographic changes of the land.

Tidal Scour: By F. P. Gulliver.

The speaker considered the forms produced by the tides upon flat coasts and pointed out that it is wholly a question of ratios that determines the form in any given locality. He did not agree with Mr. Shelford that deltas are produced only in tideless seas,* for there are weak tides even in the Gulf of Mexico, where the Mississippi mouths, and in the Mediterranean, where the Nile and Tiber deltas are found, while the Ganges produces its delta in the face of seventeen-foot tides. If the river is relatively stronger than the tides and other sea forces it will build forward a delta.

It is also largely a question of ratios between the on- and offshore action and the alongshore action which determines the production of broken or continuous shore lines. Where there is a broad area of marshes and flats, upon which the water lies at high tide, and then during the ebb scours runways beneath the level of the flats, it is inferred that the tidal action is the process which determines the shore forms. Off steeper coasts less tidal action is indicated. Where the shoreline is prevailingly longitudinal a ratio in favor of alongshore action is inferred.

A graded series of shore forms was shown, from that in which the pure tidal on- and offshore action is indicated to that in which the alongshore action seems to be dominant. The type of the tidal action was on the west coast of Florida, where the tides are weak, but indications of alongshore action are absent, therefore the ratio is greatly in favor of the tides. The runways are of the indefinite consequent or autogentic type of drainage, and the shoreline is minutely irregular without deep indentations. The salt marsh grades into the tidal flat.

The type of the dominant alongshore action was taken from the Texas coast. An offshore bar here forms a long gently swinging curve extending for 102 miles unbroken by a single tidal inlet. This bar appears to have an outline dominated by alongshore action.

Along the coasts of the world various combinations of different absolute values of these two actions may be seen in varying ratio. Where the values are larger the forms have greater vertical measure, as in South Carolina and in the Schleswig-Holstein region. The following series of maps was shown, illustrating the progressive change in ratios between the

* Min. Proc. Inst. Civ. Engin., LXXXII., 1885, 2–68.

tidal on- and offshore and the alongshore actions:

I. West coast of Florida (Coast Survey, 180, 181).

II. West coast of Schleswig-Holstein (Topographical map of the German Empire, 1:100,-000, 5, 11, 20, 21, 35, 36, 37, 55, 56, 79, 80, 109, 110,111).

III. Georgia-South Carolina coast (Coast Survey, 152, 153, 154, 155, 156).

IV. North Carolina and New Jersey coasts (Coast Survey, 148, 149; 123).

V. New Jersey, Virginia, North Carolina coasts (Coast Survey, 122; 138; 145, 146, 147).

VI. Texas coast (Coast Survey, 210, 211, 212).

MARCH 17, 1896.

1. *Exhibition of New Lantern Slides*, by J. B. WOODWORTH.
2. *Note on Penning's Field Geology*, 2d. edition, reissue of 1894, by T. A. JAGGAR, JR.

This book (published by Bailliere, Tindall and Cox, London) and A. Geikie's 'Outlines of Field Geology' (Macmillan, 1891) are the only books known to the writer which purport to deal with practical field methods of geology. Geikie's book is more popular in style, more elementary and more comprehensive; his chapter on the schistose rocks is excellent, while Penning does not even mention them. Penning's book, on the other hand, contains many useful tables, rules for finding true dip, tracing boundary lines and faults, levelling etc. The directions for note-taking do not include mention of the coördinate method of designating points on the note-book map, nor is the use of the plane-table mentioned; in these and other respects the book is not up to date for the American geologist, but on the whole the part which deals with geological surveying, sections and levelling contains much that is useful. The part devoted to paleontology by Jukes-Browne contains many useful hints for the collector, and tables of fossils that are of course intended for use in British fields. Part V. is suggestive, dealing with some difficulties likely to be encountered by the student in the field, notes on water supply, springs and wells; stress is laid on the great importance of the study of physical features in connection with geological structure. The weakest chapter in the book is that devoted to lithology, which gives elaborate and antiquated tables of physical tests for minerals, rocks and ores, but does not touch on the difficulties likely to beset the student in the field. Mr. Penning believes "it should be unnecessary to insist upon what all geological text-books so strongly recommends, that an acquaintance with the appearance and characteristics of all ordinary rocks and minerals should be formed by careful study of cabinet specimens." He believes that "tests applied in their proper order," according to his tables, "will go far enough to arrive at an accurate solution." Rutley's 'Study of Rocks' (1879) is quoted as 'an important work, recently published,' while in the lithological bibliography no mention is made of such books as Teall's 'British Petrography' or the English translation of Rosenbusch.

T. A. JAGGAR, JR.,
Recording Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 450th meeting was held on March 14, 1896. The paper of the evening was read by Hon. Carroll D. Wright, Commissioner of Labor. on 'The Factory System as an Element in Civilization,' showing that the factory elevates the low class of persons which it employs by compelling them to think more and be more orderly and careful than they otherwise would.

BERNARD R. GREEN,
Secretary.

THE TORREY BOTANICAL CLUB, MARCH 25, 1896.

IN the absence of the President the chair was occupied by Dr. T. H. Allen, first Vice-President, and there were present 39 persons.

Two new members were elected, and W. A. Bastedo appointed to act as Secretary during the absence of Dr. Rusby in South America.

As the summer season is now rapidly approaching, a 'Field Committee,' with Dr. N. L. Britton as chairman, was appointed to arrange for the weekly outings of the club.

The announced paper on Azaleas was postponed owing to the unavoidable detention of Mr. H. A. Siebrecht in the Island of Trinidad.

A new fascicle of the 'Distribution of North American Algæ,' by Collins, Holder and Setchell was shown and commended by Dr. Britton. Also a sedge *Reimaria maritima*, only lately found in Florida at Lake Worth, but having a wide distribution elsewhere.

The announced paper for the meeting was read by Miss Alexandrina Taylor, entitled 'A comparative Study of the superficial Periderm in a number of species of Salix,' and was well illustrated by diagrams. In most text-books the work of Sanio is taken as authority on the development of superficial periderm. From the large number of species of the genus Salix, he selected one as a type. The many variations from this type pointed to the possibility that, by extending the study over a greater number of species than those studied by Sanio, one might be found which might more justly be called the type of the genus. This was the object of the above study.

W. A. BASTEDO,
Recording Secretary pro tem.

WEST VIRGINIA ACADEMY OF SCIENCE.

THE fifteenth regular meeting of the Academy, which was also the first annual session of the organization, was held at Morgantown, March 24, 1896.

The following officers were reëlected:

President, Dr. A. D. Hopkins; Vice-President, Prof. Thos. C. Miller; Secretary and Treasurer, Mr. W. Earl Rumsey; Corresponding Secretary, Prof. B. H. Hite.

The President, in referring to the history and first year's work of the Academy, stated that the Academy was organized on February 25, 1895, with sixteen active members and twelve associate members, representing chemistry, physics, geology, biology, entomology, mechanical and civil engineering, zoölogy, medicine, agriculture, horticulture and general science.

Fourteen regular sessions of the Academy have been held, twenty-eight communications have been presented, and three important resolutions have been passed. The communications referred to the following subjects and branches of science:

Chemistry, 1; psychology, 3; electricity, 2; geology, 1; horticulture, 2; bibliography, 2; agriculture, 2; entomology, 2; mechanical engineering, 3; ornithology, 2; general science, 1; anthropology, 1; botany, 1; civil engineering, 1; hydrography, 2; forestry, 2.

The resolutions were with reference to the publication of topographic maps, waterways and forest preservation.

The only communication presented at this meeting besides the President's remarks was by Prof. L. C. Corbett, who announced the completion and successful test of an improved *auxanometer*, which was exhibited at work. In explanation Prof. Corbett stated that the chief features of the machine are that all parts of the instrument are mounted upon a rigid base; the usual system of proportionate pulleys has been replaced by a simple lever of the first type, *i. e.*, where the fulcrum is between the power and the weight. The record is made in ink upon a paper-bound cylinder. The rate of the cylinder is retarded to a single revolution in 24 hours. The record of each day, therefore, appears as a platted curve rather than in the form of a spiral, as is the case with recording drums making a revolution each hour. The mode of attaching the *auxanometer* to the plant has been improved upon by substituting wooden forceps with relatively broad faces for the usual bent pin; this is again connected with the recording arm of the instrument by a fine wire instead of the usual cord. In this way the objectionable features of the system of weighted cords and pulleys are overcome.

W. EARL RUMSEY,
Secretary.

NEW BOOKS.

A Compendium of General Botany: MAX WESTERMAIER, translated by ALBERT SCHNEIDER. New York, John Wiley & Sons. Pp. x+299.

Natural History of Selborne: GILBERT WHITE, with an Introduction by EDWARD S. MORSE. Boston and London, Ginn & Co., 1896. Pp. xii+251.

The Psychology of Attention: TH. RIBOT, third revised edition. Chicago and London, Open Court Publishing Co. 1896. Pp. xii+120.

An Examination of Weismannism: GEORGE JOHN ROMANES. Chicago and London, The Open Court Publishing Co. Pp. ix+221. 35 cts.

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MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

MUSEUM METHODS.

THE EXHIBITION OF FOSSIL VERTEBRATES.

THE exhibition of fossil vertebrates is a subject that may be treated from various points of view, but the purpose of the present paper is to deal with it from the standpoint of a vertebrate zoölogist, and to discuss the question what should be the relationship between the sections of a museum devoted to the exhibition of living and extinct animals. That there is, or should be, a very obvious connection between these two sections of a great museum is undeniable, although the relationship is generally ignored and, as Prof. Flower wrote in regard to the collections of the Royal College of Surgeons: "The specimens continued to be divided primarily, not according to their zoölogical or anatomical relations, but by a most inconvenient and artificial system, according as the animals from which they were derived lived before or after a particular period of the world's history."

While the *complete* divorce of recent and extinct animals is unfortunate, Prof. Flower's plan, on the other hand, goes to the opposite extreme, and while it may be applicable to such a collection as that of the Royal College of Surgeons, it does not seem applicable to the exhibition series of a large museum.

The question really at stake is, shall extinct animals be treated from a zoölogical or a geological standpoint; is it more important to exhibit the relationship of animals to one another as if they lived at the same time, or to show the forms of life which existed at a given geological epoch, and the various steps by which the existing order of things has been reached. No museum is large enough and rich enough to do both these things on an extensive scale, and the decision is practically unanimous that it is the province of paleontology to show the faunas of the past as it is that of zoölogy to show the fauna of the present. A purely zoölogical arrangement of all animals in a museum, recent and extinct, would probably fail of its own weight and extent. Prof. Flower himself recognizes the fact that there are difficulties in the way of a strictly zoölogical arrangement, for in the 'Guide to the British Museum of Natural History' he says: "Notwithstanding the objections which may be urged against this primary division of living things, it is one which prevails largely in museums, and which, owing to certain conveniences, as well as to the difficulty and expense of rearranging extensive collections and reorganizing the staff in charge of them, will probably be retained for some time to come."

Arranged geologically fossils tell the condition of life at any given stage, and show how fauna after fauna has arisen and passed away before that of the present was reached.

It might be thought that a collection could be arranged phylogenetically, but this is a physical impossibility, for, even were space available, specimens could not be so arrannged as to act as a genealogical tree and show at once their common ancestry, lines of descent and relations to one another. To do this is the province of a diagram or diagrams, and there is usually some wall space well fitted for this very purpose that is otherwise unavailable or could not be used to better advantage. Morever, the lines of descent of the majority of vertebrates are wholly or partly hypothetical, and this is a serious drawback to arranging a museum on a phylogenetic plan. Series to illustrate the line of descent of a group or species whose phylogeny is known are, however, invaluable and most instructive, and the museum which is fortunate enough to possess the necessary material cannot do bettet than to provide them. Just such a series is that illustrating the phylogeny of the horse, on exhibition at the American Museum of Natural History, in New York city.

The relations of extinct to existing animals are to be shown in two ways, or in two departments of a museum: firstly, in a synoptic, or index series; and secondly, in a general systematic system of skeletons. The synoptic series may be compared to a general introductory work on zoölogy, prepared with special reference to the needs of the public and those commencing the study of zoölogy. A systematic series is a detailed, descriptive catalogue, whose object is to furnish information for the advanced student. The idea of the synoptic series is yet in the earlier stages of development, and it seems not improbable that this will eventually come to occupy a large space in a biological museum. In the systematic osteological series the province of fossils is to round out the collection, to bridge over gaps between apparently unrelated forms and supply the missing steps which time has removed from the phylogenetic stairway. A most striking example of the need of introducing extinct forms in a collection is shown by the great gap now existing between birds and reptiles, a gap which the Dinosaurs and Archæopteryx will bridge over and by their presence make clear the affinities of these two great classes. Now a mere placing of fossils in their proper places will not do this, for the average fossil, crushed, mutilated, distorted, means very little to the average visitor. To do the thing properly we should have a complete and, preferably, a full-sized restoration of the extinct species, but this, the ideal method, is for many reasons far in the future; the *complete* structure of the majority of forms is unknown, while the cost of the knowledge and skill necessary for making such restorations puts a prohibitory tariff on their manufacture. Meanwhile the best that can be done is to supply their places with good figures,* but when this is done the drawings should be supplemented by specimens of casts of fossils to show the material on which the restorations are based and, which is almost as important, to give an idea of the size of the creature figured. Moreover, these specimens are needed as a guarantee to a somewhat suspicious public that the animals did actually exist. With the aid of these models, figures and specimens, supplemented by, or supplementary to, good labels, the relations of existing forms may be made plain and the exhibition series symmetrical.

A paleontological series then should be complementary to that of recent animals; the bulk of it should be by itself and arranged geologically, but, as fast as opportunity offers, the gaps between existing groups should be filled, so that, aided by the labels, the visitor may see that the relation between existing forms depends in many cases on species long ago blotted out of existence.

* Just how to introduce these drawings in the exhibition series is a problem which I have incubated for two years or more without hatching a good solution.

Such a series should not be too large, for its object is to show clearly the principal modifications of vertebrate structure, and the display of too many forms tends only to confuse the visitor, or general student, for whom such a series is intended. It may, perhaps, be an open question as to just what 'too large' means. In my own case it means that I would not go beyond the representation of families, although where there is much diversity of form within a family more than one species may be introduced to advantage. And when all families, living and extinct, have been properly represented, the series will be of no mean proportions.

FREDERIC A. LUCAS.

WASHINGTON, D. C.

This paper was written some time before the appearance of Sir Henry Howorth's article on Paleontological Museums in the February number of *Natural Science*, and his ideas as to the value of certain material lead me to add as a postscript some sentences striken out of the rough draft of my own article.

The questions arise as to whether it is worth while to exhibit many of the vertebrate fossils seen in museums and if they do not occupy space which might be used to better advantage. Much of the material shown, single teeth, fragments of bones, odd vertebræ and broken skulls, while, valuable enough to the paleontologist, are as caviare to the public. Even to the average student they are of little value unless he can handle them, and, while a certain amount of material is needed to impress upon the public the number and variety of the animals which have passed away, all beyond that simply tends to confuse rather than to instruct. And personally I am of the opinion that many of the objects ordinarily seen on exhibition might advantageously be relegated to the study series. F. A. L.

MUSEUM METHODS.

ON THE ARRANGEMENT OF GREAT PALEONTOLOGICAL COLLECTIONS.

A MUSEUM is defined by Dr. Goode as "an institution for the preservation of those objects which best illustrate the phenomena of nature and the works of man, and utilization of these for the increase of knowledge and for the culture and enlightenment of the people." *

The fundamental principles or aims of a museum having been defined, it is necessary to consider next in what manner collections of fossils may be arranged to fulfill these objects. The primary purposes are manifestly two: namely, to interest and instruct the *general public*, and to facilitate the researches of the *student of extinct life*. The latter class of museum visitors is composed of two kinds: namely, faunal geologists, or students of historical geology, and paleobiologists, or students of general biological phenomena.

"It is necessary to bear in mind," writes Sir Henry Howorth, "that it is a mistake to deal with mineralogy and paleontology as if they were sub-sections of geology," since "the great bulk of paleontological remains do not appertain to geology at all, but to the special provinces of zoölogy and botany."† This principle has long been accepted in the U. S. National Museum, and for many years the paleontological collections have been completely severed from the geological collections. In the Department of Geology there is, however, a small collection of fossils with samples of the rocks in which they are found, in order that the student of geology may learn to know readily the characteristic fossils of each system and the time of introduction of all the leading types of animals and plants. This collection is at present made up of American fossils, but it is intended to obtain from every province all specimens necessary to illustrate the second object of this, the '*Historical Collection*.'

*The Relationship and Responsibilities of Museums, by G. Brown Goode. (SCIENCE, Vol. II, new ser., p. 198, Aug., 1895.)

†Some Casual Thoughts on Museums, by Sir Henry Howorth. (Natural Science, Vol. VII., p. 322, Nov., 1895.)

THE GENERAL PUBLIC.

This is the largest class of museum visitors, but the one least interested directly, so it need be shown only a series of specimens properly prepared for exhibition. "A museum is rarely justified in exhibiting all its materials. An exhibition series, when properly installed, is more effective when limited than when extensive." * To interest the public the exhibition series should be mounted in an attractive manner and made intelligible by descriptive labels. Only good and well-cleaned fossils, yet not too many species, should be shown, since otherwise a rapid survey of the specimens grouped around the descriptive labels is not attainable. Drawings or prints should, when possible, accompany small fossils, and occasionally a crushed specimen may be made comprehensible by introducing a restoration or the shells of living, but closely related forms.

STUDENTS.

On the other hand, students and original investigators must have consideration of a quite different kind. Since this small but critical class of museum visitors has objects distinct from those of the general public, it will be necessary to arrange collections so as to satisfy the needs of both. The general public should be interested and instructed, while the student requires an orderly arrangement of material to facilitate ready reference.

An exhibition series is primarily intended

* Recent advance in Museum Method, by G. Brown Goode. (Smithsonian Report. U. S. National Museum, p. 57, 1893.)

for the general public and the student, and consequently should be divided into *stratigraphic* and *synoptic collections*. The investigator may advantageously make use of both of these series, but will have additional aid in the *study collections* and the *card catalogues*.

In recent years there has been a decided tendency to group all fossils according to their biological rank. This is proper if the chief object of a museum is to teach paleobotany and paleozoölogy. In large museums, however, it is necessary to teach not only everything pertaining to morphology, but the sequence of faunas, or historical geology, as well. Plants and animals do not occur in nature grouped according to their biological rank, but are associated because of their environment and geological history. If the great bulk of fossils is arranged biologically then the grouping and interactions of the individuals of a province or zone are apt to be lost sight of. Paleontologists seeking for the relationship which the various provinces bear to another, or the presence or absence of barriers against the dispersal of floras and faunas, will be seriously embarrassed by any arrangement other than stratigraphic. The dual evolution of the horse, or of the Terebratellidæ among the Brachiopoda, are problems both of the faunal geologist and of the systematic zoölogist as well.

A stratigraphic exhibition collection aims to show only the essential animals and plants of various well-marked geological horizons, and these systematically arranged, both geologically and biologically. It should be sufficiently extensive to illustrate clearly Historical Geology, or the order of distribution of fossil remains throughout geologic time.

It is seemingly neither proper nor advisable to note all the minor geological horizons in large stratigraphic collections like those of the National Museum. For a clear demonstration of the facts of faunal geology, it is sufficient to group all the organisms of the Cambrian system into three divisions, representing the Lower, Middle and Upper Cambrian, respectively. The Ordovician system, in like manner, should be separated into Calciferous-Chazy, Trenton and Cincinnati groups. The labels accompanying the species should indicate the minor, or local, geological horizon. Practice has also shown the advantage of grouping together all the fossils of each basin or geological province, since in this way only is it possible to indicate clearly the relations which the various provinces bear to one another. Such an arrangement will necessarily cause duplication of certain species, but this is not objectionable, as the forms recurring in two or more provinces illustrate to what extent geographic dispersion has taken place. This method of installation was introduced in the Cretaceous collection of the U. S. National Museum some years ago, by Dr. C. A. White, and has proven practically useful to working paleontologists. It is also in harmony with Sir Henry Howorth's idea that "there should be no attempt made to fill up gaps in one area by inserting evidence from another." *

A stratigraphic collection will also show the introduction in time of the various types of organic beings, and the gradual rise from the ancient and less complex floras and faunas to those of greater complexity characteristic of the more recent geological epochs.

In large museums it is advisable to have distinct and separate paleobotanical, invertebrate and vertebrate collections. Fossil plants and vertebrates are often so large and bulky as to require a method of installation quite different from invertebrate fossils. In small or local museums the various animals of a zone should be kept together,

* (Ibidem, p. 323.)

since it is their province to illustrate the detail of their natural surroundings.

A *Synoptic Collection* should show the anatomy, embryology, terminology and evolution of every class, together with all the generic steps through which each family has gone in past ages. The first two divisions of the synoptic collection may be illustrated by models and drawings, the terminology by specimens and drawings, colored after the plan so successfully initiated by Bather for the crinoids and Lucas for the vertebrate skull. The genera should be illustrated by typical material of the species on which the genus is based, either by specimens or by figures, or by both, while the labels should give fully the geologic and geographic distribution.

To install the material illustrating the anatomy, embryology and terminology of a class is not difficult, but it is somewhat hard to determine how the generic material shall be shown so as to illustrate the devious paths through which a given class has passed —in order to set forth the course of its evolution. This may be accomplished by grouping the generic tablets of each family in one or more vertical columns. At the base of each is the label giving the name and a short definition of the family characters. The families should be grouped into superfamilies, orders, superorders, and the characters upon which these divisions are based should be clearly set forth on the accompanying descriptive labels. A definition of the class and the known phylogeny should also be displayed in each exhibition case. Plants and vertebrates in the synoptic series, because of their generally large size, must for the most part be illustrated by mounted pictures.

A recent species of all genera having fossil representation should be introduced into these collections, and on each tablet should be given the present specific representation and geographic distribution of the genus.

In the synoptic collections, more than anywhere else, is the need of technical terms necessary for a clear definition of the various divisions illustrated. It is for this reason that each class of organisms in this exhibition series should be accompanied by specimens or drawings colored to attract attention to the part to which the term is applied.

The synoptic collections need not be limited to the illustration of the generic evolution of the classes, but may be advantageously extended to illustrate the evolution of certain specially interesting families, genera, or even species. What series could be more interesting than one illustrating the evolution of the horse or one showing the enormous time dispersal of Lingula and Crania or Pleurotomaria or of Leptœna rhomboidalis and Atrypa reticularis?

The *Study Series* is not, as a rule, on exhibition, but is stored unmounted in drawers arranged in paper trays. This is the great reserve collection of a museum, and from it the curator derives material for the exhibition series, while the paleontologist or biologist depends upon it for purposes of study. This collection contains no duplicate material for distribution or exchange and must be kept intact. The study collections, since they have no uses other than those just mentioned, should therefore be arranged stratigraphically, this seemingly being the only available method for the administration of so vast an assemblage of fossils. The specimens of each class should, of course, be kept together within each geological group, and this is true also of the floras and faunas of each province. The above treatment of the study collection does not perhaps accord with a strictly biological view, but the needs of the biologist can be provided for by complete card catalogues of all the fossils in the museum.

The *Catalogue* is the most important agency in the possession of the curator, and its management is the highest test of his capabilities. Every species from a single locality, in whatever permanent collection it may be, should be registered upon a separate card giving name, systematic position, terrane, locality, number of specimens, source whence obtained, place of disposition in museum, museum register number, and, if a type published or even a specimen especially referred to in a publication, an exact reference should be given to page and plate. Such cards should be arranged alphabetically, and without regard to any other classification. By the aid of this catalogue, the curator is in the position to know just what material the museum has in stock, and can respond promptly to requests for the loan of material, since the place of any specimen can be ascertained at once. The bulk of the fossil collections being arranged stratigraphically, faunal geologists and paleontologists will be able to secure promptly any desired information without the necessity of referring to the catalogues, while other students of extinct life can refer to any or all the species of a group in the museum by the aid of the catalogues. The cards of this catalogue in use in the U. S. Museum are $4\frac{1}{2}$x$6\frac{3}{4}$ inches.

Additional aid can be given the systematic biologist by providing a generic catalogue grouped into classes. Only those genera of which there is material in the museum will have representation in this catalogue. On these cards may also be given the type species and its locality and the place of original description.

The *Duplicate collection* exists for exchange purposes only, is constantly changing, and requires no attention except in the matter of preservation of identifications.

In *Recording the specimens* in the U. S. National Museum, each lot of fossils is given a general accession number as soon as received, and later, when the material has been studied, each species from a single locality is given a permanent '*museum register number.*' The latter, when practicable, is written upon each specimen, and opposite this number in the record book is entered the name, locality, date and any remarks pertinent to its history. To fossils brought together by the U. S. Geological Survey are attached small, round, green or yellow tickets, upon which are written numbers referring to the '*locality book.*' This method is preliminary to permanent record. Either system permits the assembling in one tray for study, all the material of a species from many localities, without danger of confusing their history. "Specimens can be named at any time, but the locality once lost, the object becomes comparatively valueless. The record of donors should be accurate and complete so that the specimens from any given source can be traced at once to their location." *

Types and illustrated specimens should have in addition to the museum register number, some conspicuous mark to call attention to their great scientific value, and to guard against loss. In the U. S. National Museum a small, green, diamond-shaped ticket is pasted on each specimen; this being a method long in use by Prof. James Hall.

CHARLES SCHUCHERT.
U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.

THE FLOW OF THE CONNECTICUT RIVER.†

THERE is a general and doubtless well-founded belief that the cutting of the forests is injurious to the flow of the streams whose basins are thus denuded. This belief is based upon the common experience of men long familiar with the streams in question, and is also supported by theory. Few opportunities, however, exist for definitely measuring the effect that is produced, for the reason that upon very few streams have

* Goode. (loc. cit., p. 58.)

† Read before the American Forestry Association, 1895.

reliable and long-continued observations of discharge been made. Your Association meets this year upon the banks of the Connecticut river, upon whose upper drainage area the clearing away of the forests has been for many years, and still is, progressing. At two points upon this river, Hartford and Holyoke, an unusual number of continuous observations of flow have been made, and it has seemed to me desirable to examine them and see whether they reveal any changes in the character of the flow which could be ascribed to the cutting of the forests.

At Hartford the tributary area is about 10,200 square miles, and for a period of over fifty years records are available of the maximum freshet height of each year. Further, observations to determine the daily rate of discharge were begun in 1871 by General Theodore G. Ellis, and were continued without interruption until 1886, although for 1882 and 1883 the figures are not at hand. There was thus obtained a record having few parallels in this country, and it is deeply to be regretted that the United States engineers should have permitted it to be discontinued, as was done in 1886. At Holyoke, where the drainage area is about 8,000 square miles, the Holyoke Water Power Company has maintained since 1880 a daily record of the discharge of the river past that point, which record is still continued and is on the whole the most valuable that now exists regarding the discharge of this stream.

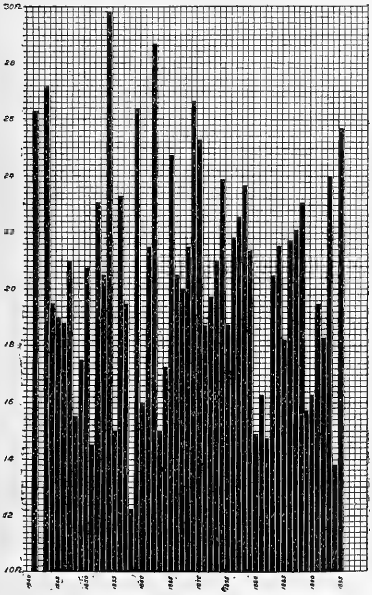
The effect of forest cutting within the past twenty-five years should, of course, be most evident in the upper river, since it is near the head waters that operations have been mainly conducted in that period. It will be of interest, however, to study the only records that are available—those for the lower river—and see if we can there detect any marked change in the nature of its flow.

The theory as to the effect of forests is, that by shading the ground they tend to prolong the melting of snow in the spring, and thus to prevent excessive freshets, as well as to maintain the naturally decreasing flow of late spring and early summer. Further, by reducing the evaporation from the ground, by obstructing the free flow of surface water after rains, as well as by conserving the snows, they tend to maintain a large volume of ground water, which, issuing in visible springs or in invisible seepage, must of course be the reliance of all streams in dry weather. The effect of extensive forest-cutting might, therefore, be expected to be an increase in the number, suddenness, and height of oscillations, and on the other hand a more speedy falling away in summer and a lower range of dry weather flow. To reveal clearly any permanent change that may have taken place in the Connecticut river it seems to me that we should have continuous records of flow for a longer period than they are yet available, and that for successive groups of years curves should be constructed, by averaging for each group the lowest daily discharge, the second lowest, and so on, irrespective of calendar order. The distribution of the flow would thus be shown in a manner warranting the drawing of positive conclusions. Because the labor involved in such a treatment is large, and because the records cover so short periods as hardly to warrant it, I have limited myself to an examination of freshet heights and of low-stage flow.

The heights above low water datum to which the river has risen in freshets at Hartford since 1840 are as follows:

	1841......26.3	Apr.	1869......26.7
	1843......27.2	"	1870......25.3
Dec.	1844......19.5	May	1871......18.7
Apr.	1845......19.0	Apr.	1872......19.7
Mar.	1846......18.8	"	1873......21.0
Apr.	1847......21.0	Jan.	1874......23.9
Jan.	1848......15.5	Apr.	1875......18.7
Nov.	1849......17.5	"	1876......21.8

May	1850......20.8	Mar.	1877......22.6
Jan.	1851......14.5	Dec.	1878......23.7
Apr.	1852......23.1	May	1879......21.4
Nov.	1853......20.5	Apr.	1880......14.9
May	1854......29.8	May	1881......16.3
Jan.	1855......15.0	"	1882......14.8
Aug.	1856......23.3	Apr.	1883......20.5
Feb.	1857......19.5	"	1884......21.5
Mar.	1858......12.3	"	1885......18.2
"	1859......26.4	May	1886......21.8
"	1860......16.0	Apr.	1887......22.1
Apr.	1861......21.5	May	1888......23.1
"	1862......28.7	Nov.	1889......15.7
May	1863......15.0	Oct.	1890......16.3
Apr.	1864......17.3	Apr.	1891......19.5
Mar.	1865......24.8	Jan.	1892......18.3
Feb.	1866......20.5	May	1893......24.0
Apr.	1867......20.0	Apr.	1894......13.8
Mar.	1868......21.5	"	1895......25.7



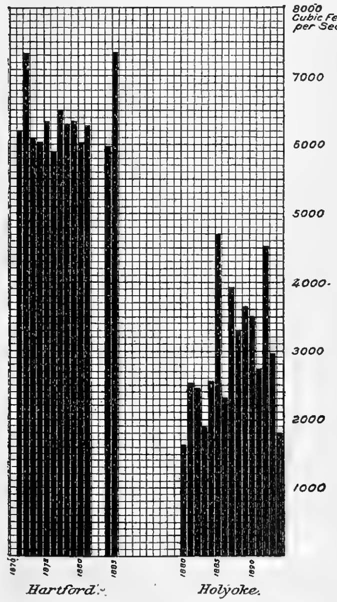
Freshet Heights in Connecticut River by Hartford Gauge.

Averaged for successive periods these give:

1841–49	Average height	.......20.6	(1842 missing.)
1850–59	"	"	.......20.5	
1860–69	"	"	.......21.2	
1870–79	"	"	.......21.7	
1880–89	"	"	.......18.9	
1890–95	"	"	.......19.6	

An examination of these figures and of a graphical representation of the yearly freshet heights discloses, it seems to me, no permanent change. The highest freshet was in 1854, the lowest in 1858, and only twice has the height of 27.7 feet attained in 1801 been exceeded. Apparently there was a gradual increase in the *average* height down to 1880, while at the same time there was a marked and steady decrease from 1854 to 1880 in the heights of the more extreme freshets.

In considering the dry weather discharge of the river I have taken as a basis for comparison the average flow for the lowest consecutive period of four weeks in each year, for which I find the following figures, which have also been plotted to scale:



Low Water Flow in Connecticut River.

Connecticut Rive t Hartford.

	Avg. discharge in cu. ft. per sec. for lowest 4 weeks period.
Sept. 9—Oct. 6, 1871	6200
Feb. 11—Mar. 9, 1872	7330
Aug. 25—Sept. 21, 1873	6090
Oct. 24—Nov. 20, 1874	6020
Jan. 6—Feb. 2, 1875	6330
Aug. 11—Sept. 7, 1876	5900
Jan. 1—Jan. 28, 1877	6490
Sept. 25—Oct. 22, 1878	6280
Oct. 5—Nov. 1. 1879	6350
Sept. 30—Oct. 27, 1880	6020
Sept. 22—Oct. 19, 1881	6270
Sept. 8—Oct. 5, 1884	5960
Sept. 17—Oct. 14, 1885	7320

Connecticut River at Holyoke.

	Avg. discharge in cu. ft. per sec. for lowest 4 weeks period.
Aug. 22—Sept. 8, 1880	1620
Sept. 19—Oct. 16, 1881	2510
Aug. 20—Sept. 16, 1882	2470
Sept. 2—Sept. 29, 1883	1890
Sept. 7—Oct. 4, 1884	2550
Feb. 28—Mar. 27, 1885	4690
Aug. 27—Sept. 24, 1886	2310
Sept. 23—Oct. 20, 1887	3930
July 16—Aug. 12, 1888	3290
Aug. 21—Sept. 17, 1889	3640
July 26—Aug. 22, 1890	3500
Sept. 23—Oct. 20, 1891	2740
Sept. 10—Oct. 7, 1892	4520
Jan. 12—Feb. 8, 1893	2970
Aug. 19—Sept. 15, 1894	1800

In these figures no change for the worse appears in the dry weather flow; in fact, the Holyoke diagram displays a general improvement from 1880 to 1893. It is true that this improvement may have been due to increased reservoir facilities on the tributaries of the main river, the artificial control thus exercised over the stream tending to modify and disguise all natural changes so as to increase the difficulty of drawing accurate conclusions.

Even though an unfavorable change were apparent in the lower water volume, it would be necessary, before assigning a cause for it, to study the rainfall of the basin for the period in question and to consider what the probable influence of that had been; but, as it is, such a study seems unnecessary and my general conclusion is, that so far as the flow of the lower river is concerned, no permanent change for the worse in the past twenty-five years is apparent. In closing I desire to express my indebtedness to Mr. F. H. Newell, Secretary of this Association, for placing at my disposal valuable data regarding the discharge of the Connecticut river; and to call attention to the importance of the work being done by the United States Geological Survey in attempting to obtain continuous records of the flow of many of the rivers of this country.

DWIGHT PORTER.
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AMERICAN AMBER-PRODUCING TREE.

THE world's supply of amber in all ages appears to have been drawn from the shores of the Baltic, where it is still mined or cast up by the waves in commercial quantities. Amber occurs also in numerous inland localities throughout Europe, as in the vicinity of Basle, Switzerland, and in France and England. It is also found on the coasts of Sicily and the Adriatic.

Up to the present time amber has not been found in North America in commercial quantities, although it is known from a number of widely scattered localities. It appears to have been first reported by Dr. G. Troost from Cape Sable, Magothey River, Maryland, in 1821. * It has also been found in small quantities near Cañon Diablo, Arizona; near the Black Hills, in South Dakota; Gay Head, on Martha's Vineyard; Trenton and Camden, New Jersey; Chesapeake and Delaware Canal, and a number of more or less doubtful localities.

The Cape Sable locality has been visited several times recently by Mr. Arthur Bibbins, instructor in geology in the Woman's College of Baltimore, and a careful search made for the amber.

This place is somewhat difficult of access from Baltimore, and the visits to it were made possible by the courtesy of Dr. W. L.

* Am. Journ. Sci., Vol. III. 1821. pp. 8–15.

Rasin, of Baltimore, who placed his commodious tug at Mr. Bibbins' disposal for the investigation.

A number of small pieces of amber were found *in situ* in thin strata composed largely of comminuted lignite. By careful excavation Mr. Bibbins was able to expose a log of lignite which showed in several cases the amber in its interstices. Through the kindness of Mr. Bibbins I have been enabled to investigate the structure of this amber-producing tree.

This log was found about 20 feet below the surface in strata provisionally regarded by Mr. Bibbins as of upper Potomac (upper part of Lower Cretaceous) age. About 4 feet in length of the log was taken out. It was very soft when excavated and hardly to be distinguished from the surrounding matrix. When dried by exposure to the air it becomes thoroughly disintegrated into minute fragments, and even when treated by hardening substances still retains so much iron pyrites that it appears impossible to stop its reduction to powder. Before fossilization the log had been completely honeycombed, apparently by a Teredo-like mollusk. This condition made its compression easy, and when excavated it was found to be much flattened. It was about 14 inches in long, and 6 inches in short diameter.

When observed with the naked eye or with a low-power lens the wood appears to be admirably preserved. The grain shows very clearly and, when it is split radially, faint traces of the medullary rays can be made out. It is very soft and may be sliced with an ordinary razor without treatment of any kind. But when studied under a compound microscope it is found at once that much disintegration and distortion has taken place. The wood cells have been flattened and crushed until it is quite impossible to make out their character. Figure 1, magnified 320 diameters, represents the lumen of the cells. It is impos-

FIG. 1.

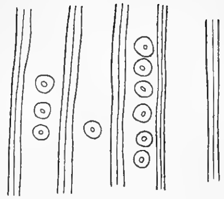

FIG. 2.

sible to make out their outline or to determine whether or not there were rings of growth.

The radial section appears the best preserved of all. An exceptionally well preserved portion is shown in figure 2. It shows the cell walls to be thick, and also that the radial walls are provided with a single series of large pits. The outlines of the outer and inner circles are so obscure that it is not possible to make satisfactory measurements. (In the drawing they of course appear distinct, but they are only approximate.) The medullary rays should be observed in longitudinal section, but they can not be made out with sufficient distinctness to be drawn with the camera. The usual number appears to be four, but it may vary from two or three to as many as seven.

The tangential section, of which a fragment is given in figure 3, shows the extent

FIG. 3.

FIG. 4.

to which the medullary rays have been compressed. The opposite walls are pressed closely together. As stated above, the usual number appears to be four.

Scattered in numerous places among the wood cells are little opaque spheres of an intensely black substance (shown in figure 4) which is probably amber. Two contiguous cells split apart and in the interval the spheres or drops occur. This intimate association of these, as well as that of the undoubted pieces of amber, leave no doubt that they are found in connection with the tree which produced them.

This amber-producing tree was of course coniferous, but the poor state of preservation renders its generic determination more or less open to question. The Baltic amber-producing trees, of which some six species are known from studies of the internal structure, were pines (Pinites), but no evidence could be found to show that the one under discussion belonged to this group. Indeed, it is hardly to be expected that the genus would have had the same peculiarities from the lower cretaceous to the oligocene, the age to which the Baltic amber belongs. The large resin tubes and compound medullary rays are characters of the pine group, but are absent in this. On the other hand, as nearly as can be made out, the structure is that of Sequoia or Cupressinoxylon as the wood is known in the fossil state. It is very much like certain lignites that have been described from the Potomac formation, but of which too little is still known. This view is further strengthened when it is remembered that some fifteen species of Sequoia are already known, from the researches of Fontaine, to have lived during Potomac times.

I venture to propose for this American amber-producing tree the provisional name of *Cupressinoxylon ? Bibbinsi*, in honor of the collector, who has done so much to elucidate the complex history of the Potomac formation and its vegetation.

F. H. KNOWLTON.

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*ZOÖLOGICAL NOMENCLATURE—A PROPOSAL.**

THE discussion on zoölogical nomenclature, which was held, as announced in our last number, by the Zoölogical Society of London on March 3d, was introduced to a crowded meeting by Mr. P. L. Sclater, F. R. S., in a concise and careful paper, and the points to which he drew attention were warmly debated beyond the usual hour. The discussion dealt with certain differences between the rules drawn up by the German Zoölogical Society for the guidance of the compilers of the Synopsis of the Animal Kingdom ('Das Tierreich') which that Society is preparing, and the rules known as the Stricklandian Code, which for many years governed, or were supposed to govern, the usage of British naturalists. The discussion turned chiefly upon the following questions: First, may the same generic names ever be used for both animals and plants? Secondly, may the same term be used for the generic and trivial name of a species, as in the well-known instance of *Scomber scomber ?* Thirdly, are we to adopt as our starting point the tenth edition of Linné's *Systema Naturæ* in preference to the twelfth edition? These questions are answered in the affirmative by the German code, and in the negative by the original Stricklandian. We do not propose to discuss them here: it is natural that there should still be found, especially among the older zoölogists of this country, many to support the old-established British practices; in this, as in all other matters of nomenclature, convenience, not principle, is concerned, and it cannot be gainsaid that the general usage of zoölogists, at all events in other parts of the world, becomes daily more and more in harmony with the rules adopted by the German Society.

Were we again to open our pages to the discussion of this thorny subject, we should

*From proof sheets of an editorial article in *Natural Science*.

probably prefer, as did many of those who spoke at the Zoölogical Society's meeting, to discuss points that appear of more vital importance; but after listening to the various ingenious arguments, and to the animated rhetoric, punctuated by shouts of applause, that were poured forth the other evening, we felt more inclined than ever to doubt the value of these discussions. There are, it appears to us, fundamental defects that so far have pervaded all of them. A casual glance at the list of modern codes of nomenclature exhibited by Mr. Sclater was enough to show how very limited has been the authority of those bodies that have, from time to time, ventured to suggest laws for the zoölogical world. Either it is a committee of a section of the British Association, or it is the Zoölogical Society of France, or of Germany; or, again, at one moment we find the ornithologists meeting in conclave, at another the paleontologists, at yet another the neontologists; even when we see a code drawn up and passed by two International Congresses of zoölogy, we must not, as the President pointed out, flatter ourselves that more than a very few of the actual workers have assented, or have even been consulted. Consequently, the best of the codes that has yet been proposed (and which that be, each reader must decide for himself) has lacked the authority and the sanction that alone can make it of value. For we must insist upon this point, if upon no other, that it is not the wording of any particular law that is of consequence, but the power of enforcing it. We venture to say that to the very best code that could possibly be drawn up each individual zoölogist would remain a recalcitrant, were it only in so trivial a point as the insertion of a comma or the use of a capital letter.

If it be true that we come to some such *impasse* in whatever direction we proceed, it is worth considering whether we cannot follow some course more productive of finality than is this perpetual codifying of our whims and fancies. And here we would take up and push to their logical conclusion the suggestions that were thrown out at the meeting by Mr. H. J. Elwes and the President. It is not enough to imitate Mr. Elwes, and to follow the last monograph or the last catalogue of some great museum; for other monographers will arise, and rival museums will publish rival catalogues, each with its own system of nomenclature. Nor is it of much use to follow those British ornithologists of whom the President told us, who some years ago made a vow to adopt such and such fixed names for all the British birds; for the science of zoölogy is not confined to these islands, and those who withdraw from the main stream of progress will either find themselves left high and dry, or be forced to rejoin it as laggards and out-of-date. But the course that might be pursued is suggested to us by this very enterprise of the German Zoölogical Society. Let us suppose that, instead of shrinking from the magnitude of the undertaking, instead of insinuating its impossibility, and instead of drawing their purse-strings tighter, the zoölogists of the world were to give a mandate to the German Zoölogical Society to proceed with the work, and were to assist them generously by every means in their power, then we should have a complete set of names for all living species of animals. This, it is true, would not be enough. To draw up such a correct list of names without consulting the paleontologists is impossible, and, even were such a list drawn up, it would, for the purpose we now intend, be valueless. But let us further suppose that some body, such as the German or the English Zoölogical Society, could be found to draw up a list of all animal species, fossil as well as recent, then it would at all events be perfectly possible for the zoölogists of the world to accept that list, and to say: "Whether these names be right or wrong according to this or that code of nomenclature, we do not know and we do not care; but we bind ourselves to accept them in their entirety, and we hereby declare that the date when this list was closed for the press shall henceforward be the date adopted as the starting point for our nomenclature."

We have put this proposition in a broad manner; there are, of course, numerous minor points to be taken into consideration. The preparation of a mere list would be an enormous undertaking; we learn from Dr. David Sharp and the workers on the *Zoölogical Record* that there are 386,000 recent species; no one has reckoned the number of extinct species. Some such work as the 'Index generum et specierum animalium,' now being compiled with a minimum of support and under constant difficulties by Mr. Charles Davies Sherborn, must form the basis of any such synopsis as that here proposed. The first duty of naturalists is to help Mr. Sherborn, who works at the British Museum under a Committee of the British Association. We also have to consider what is to be done when our list is completed. First of all, it must constantly be kept up to date. It seems to us that some restriction will have to be laid upon the place and manner of publication of new specific names, and we would suggest that, when the time comes, no specific name should be recognized unless it be entered by the author at some central office, together with a properly published copy of the work in which the description appears. The name would then be checked, dated, and placed at once in the index.

It is not contended that the acceptance of our proposal would obviate the need for a code of nomenclature. But it would be a far simpler code, free from the doubt as to whether its rules were to be retrospective; and its action would be uniform and stringent. Nor is it contended that the validity of a name carries with it the validity of a species. For the stability of nomenclature, it would be advisable to include in the list as many names as possible, and to leave to specialists the duty of deciding on the distinctness and systematic position of species. But whether our aim be the completion of an Index, the compilation of a Synopsis, or the construction of a Code, it is necessary that there should be absolute and loyal coöperation between zoölogists of every kind and every country, since by this means alone can the required sanction be obtained.

CURRENT NOTES ON ANTHROPOLOGY.

THE CHILD MIND AND THE SAVAGE MIND.

PROF. JAMES SULLY, who fills the chair of 'philosophy of mind,' in University College, London, makes it a point in his recent work, 'Studies of Childhood,' to institute frequent comparison between the mental action of children and of savage adults. A few of his conclusions may be mentioned:

On the important question of the origin of languages he is not quite positive. He believes children 'show the germs of true grammatical feeling,' and believes "they might develop the rudiments of a vocal language;" but elsewhere quotes with seeming approval Max Müller's assertion that they could not do this, 'if left to themselves;' which begs the whole question. Unfortunately, Prof. Sully has not read Mr. Horatio Hale's admirable studies. He quotes them only at second hand.

Death presents itself to the child just as the savage. It is not annihilation, but a continued existence, partly with the body, partly separate from it. The lower animals live after death just as do human beings. The individuality to the child, as to the savage, is multiple, not single, whether in life or death.

The colors first recognized and most enjoyed by children are red and yellow, and bright, glistening objects are equally attractive to both.

POINTS IN PRACTICAL ANATOMY.

IN the Bulletin of the Anthropological Society of Paris, for December, 1895, Dr. Chudzinski studies the radical differences presented by the rectus abdominis muscle. It is highest developed in the white race, least in the yellow race, while in the black race it is intermediate. Its anomalies and irregularities are more numerous in the colored races, and its intersections are higher in both these reaching their maximum in black women.

In the same Bulletin Dr. Montard-Martin reports observations on congenital and hereditary malformations of the fingers and toes. He reaches the general conclusion that these deformities are transmitted most directly and persist longer in the descendants of the same sex as the person transmitting them; *i. e.*, if derived from a maternal ancestor they will first disappear in the male decendants and *vice versa*.

THE ANCIENT ILLYRIANS.

ACCORDING to Frederick Müller, the Illyrians were the first to separate from the primitive Aryan stock, and left their Northern home to settle in the Balkan peninsula and on the coasts of the Adriatic Sea (*Allgemeine Ethnographie*, p. 70).

They have, therefore, a peculiar interest to students of Aryan ethnography, and the recent researches into their ancient sites and tombs merit attention. They are reported upon by Hedinger in the March number of the *Correspondenz-Blatt*. One of the largest cemeteries is Glasinac, 45 kilometers southeast of Sarajèvo. It contains 20,000 graves, chiefly dating from the bronze and early iron period. Glass, enamel and amber abound, but the pottery is comparatively rude, none of it being made with the potter's wheel. The oldest graves take us back at least 1000 B. C., or about the time of the Homeric wars. Even then the Illyrians were a sedentary, agricultural people, acquainted with metals and fairly advanced in the arts. They flourished without serious interruption until about 400 B. C., when they were almost destroyed by the Celts, who at that time overran southern Europe. The modern Albanians, or Skipetars, are the descendants of those who escaped the disaster.

THE ETHNOGRAPHY OF BURMA.

THE supposed discovery of relics of tertiary man in Burma, by Dr. Nöthing, gives interest to the recent researches into the ethnography of that land.

The present population represents two strata of immigration. Much the oldest is that to which belong the Khmer, the Mon and similar tribes. An investigation of their dialects (principally by F. S. Forbes and E. Kuhn) revealed the unexpected result that they are members of the Kohl family of central and northern India, belonging therefore to the 'Dravidian' group.

The Burmese proper claim to be descended from the Indian Kshatryas; but this is incorrect. They are remarkably similar in physical type and temperament to the Tibetans; and in the Journal of the Royal Asiatic Society, January, 1896, Mr. B. Houghton shows that their language is a Tibetan dialect, and that they migrated from the western end of the Tibetan plateau many centuries B. C. Even then they were agricultural, knew iron and other metals, and had extended trade relations.

The peculiar ancient stone implements found in Burma, of the form known as 'shouldered celts,' asymmetric antero-posteriorily are shown by A. Grünwedel (in 'Globus,' Bd. 68, No. 1.) to be of the same size and shape as others from the Kokl territory of India.

D. G. BRINTON.

NOTES UPON AGRICULTURE AND HORTICULTURE.

SOIL IRRIGATION.

A good deal is being done in the experiment stations in the application of water to soils for purposes of crop growing.

From the last issue of the Experiment Station Record (Vol. 7, No. 6), under the head of agricultural engineering, particular mention is made of experiments in irrigation at the Utah Station. Under farm irrigation it is gathered that two feet of water is required for best results with grains upon clay soil, while a sandy soil needs three and a half feet. For wheat, clover and timothy the intervals between irrigation should be about twelve days. With spring wheat there was a decrease of yield when there were more than three waterings. Better results are obtained by day than by night irrigation. Fall watering favored timothy, but not winter wheat. The flooding system is superior to the method by furrows, and the acre-foot unit is recommended by Professor Mills for general adoption.

Under orchard and vineyard irrigation Professor Richman holds to the opinion that the best plan is to apply the water but a few times, supplying enough to reach the deeper roots of the trees. Young trees require more frequent watering than old ones, and the opinion is erroneous that water injures the trunk of trees even when confined around the base by heaped-up earth.

Among other bulletins cited is one (No. 25) from the Nevada Station, largely a compilation from publications of the Colorado and Wyoming Stations, etc., which deals with water storage measurements, pumping, etc. Another is No. 6 of the Montana Station, upon measurements of water, giving value of water, water duties and tables for discharge over weirs. Several other items are given upon this general subject from Kansas and Washington.

There is a manifest growing interest in agricultural engineering, as it relates to the distribution of water over the soil.

While irrigation has been and will continue to be a leading feature of agriculture in the arid regions of the West, there is little doubt that it will also increase in importance in the East. Field irrigation may not become a common practice along the Atlantic coast, but it seems likely that methods will be provided for supplying water to truck and berry fields when there is a shortage due to drouth.

In a small way experiments with garden crops have been carried on during the past summer at the New Jersey Station, and the results published in bulletin No. 115. From the summary the following facts are gathered: "Irrigation is quite favorable to bush beans, there being nearly three times as many pounds of pods upon the belt receiving water as elsewhere in the field, besides the quality was superior. * * * Irrigation prolonged the period of fruitfulness of peppers and the yield was nearly doubled. * * * Irrigation greatly increased the leaf development of turnips, and probably there would have been a corresponding growth of roots were it not for the clubroot which practically ruined the crop. * * * Irrigation for celery gave satisfactory results. * * * In marketable product in pounds the difference was three to one, and in marketable value eight to one, in favor of irrigation." Equally good results may be hoped for with strawberries should there be a dry spell just preceding fruiting time.

Irrigation in the greenhouse is taking shape by means of tiles or pipes with frequent outlets within the soil, that is, the various experiments at the Ohio, Cornell, West Virginia and other Stations all point toward the watering of greenhouse-grown plants from below or by what is termed sub-irrigation.

THE FIRST PRINCIPLES OF AGRICULTURE.

THE above is the title of a neat book of over two hundred pages by Edward B. Vorhees, Professor of Agriculture in Rutgers College and Director of the Experiment Stations of New Jersey. In a clear and attractive manner the important first principles of the crop growers' craft are taken up in logical order. There are fifteen chapters, beginning with the plant constituents and running through the formation of soils, their composition and improvement, and natural and artificial manures. To the latter fully a quarter of the book is devoted, there being a chapter each upon nitrogenous materials, phosphates, superphosphates and potash, salts and methods of buying, etc. Rotation of crops, selection of seed, growth of animals, feeds and fodders, principles of breeding and products of the dairy, complete the list of general subjects treated. To this is added composition and coefficient tables as an appendix, closing with an index.

The author has felt the need of a work like this in his college teaching, and in connection with his work among the farmers themselves. Prof. Voorhees believes that agriculture can be taught in the country schools and "it is here that such education must begin if it is to reach and influence the masses of farmers." With this conviction and the endorsement of the New Jersey Board of Agriculture and State Grange the work has been prepared. It is, however, a book for any farmer, for the contents deal with those general principles that know no State or country. Great stress has been laid upon fertilizers, for Prof. Voorhees, from his especially large experience in this branch of the work, sees that a clear understanding of manures, in the broad sense, and their rational use, lie at the bottom of all future successful agriculture in this country.

BYRON D. HALSTED.

CURRENT NOTES ON PHYSIOGRAPHY.

THE ECONOMIC IMPORTANCE OF PENEPLAINS.

THE relation of geological deposits that have economic value to physiographic conditions, ancient and modern, has often been illustrated. Coal beds record ancient lowlands with extensive marshes of imperfect drainage. In Pennsylvania the preservation of the coal now remaining is due to its having lain all through Mesozoic time out of reach of the weather, that is, beneath baselevel; for practically all the coal there is below the level of the Cretaceous peneplain of that region. Again, the limonite iron ores of the Appalachian valley are products of leaching on surfaces of low grade, the floors of Tertiary valley lowlands, now uplifted and more or less dissected. A recent essay by Hayes (16th Ann. Rep., U. S. G. S.) shows that the Georgia and Alabama pocket deposits of bauxite, the oxide of aluminum and an important source of this metal, are limited to the Tertiary lowland of the Coosa valley; thus again exemplifying the same general principle. The source of the deposits is thought to be in the underlying Cambrian shales; the faults of the regions afford paths for upward transportation; and the low grade of the former valley lowland promoted local accumulation in pockets. Similar deposits may have been formed on the more ancient Cretaceous peneplain of the region; but these have vanished with the uplift and great dissection of that lowland. Similar deposits may in future be formed when the narrow valley trenches of to-day shall have widened into broad floors. But at present the bauxite pockets are practically limited to the unconsumed portions of the Tertiary valley lowland. Hence they stand at altitudes of about 850 feet, although ranging across the bevelled edges of several thousand feet of strata. As a guide in searching for new localities, this generalization is of manifest value.

DETRITAL SLOPES IN ARID REGIONS.

AN excursion into eastern California, inland from the Sierra Nevada and north of the Mohave desert, is described by H. W. Fairbanks in the *American Geologist* for February. The chief mountain ranges are held to be uplifted blocks, little dissected; the form that they had before uplift does not appear to have been considered. The long slopes of coarse detritus reaching forward from the mountain flanks into the desert valleys, constitute characteristic features of the region, as has been pointed out by various observers. Alluvial fans occur with a radius of from six to twelve or fifteen miles. Laterally confluent fans form nearly uniform slopes. A granite ridge south of El Paso range is almost buried in its own waste; the long marginal slopes of gravel and boulders extend headwards into the shallow cañons and reach almost to the ridge summits. Viewed from a distance of ten miles, but little of the granite appears to project above the gravel slopes.

Following a use of terms that needs reform, Fairbanks mentions this ridge as an excellent example of baselevelling. But is it not manifest that, even when the heads of the granite mountains are worn down still lower, the general surface of the detrital slopes will continue to suffer slow degradation for a long time; and furthermore, if the climate of the district had been rainy, is it not true that the existing slopes would not have been assumed. The graded form that the region has almost reached is a function of time and climate as well as of altitude with respect to baselevel. These important topographic controls are neglected if the region is said to be baselevelled.

THE ICE FALL ON THE GEMMI PASS.

THE ice fall from near the summit of the Altels peak, southeast of the Gemmi pass, on September 11th, last, is now fully mapped, figured and described by Heim in a most interesting report made to the Swiss glacier commission (Die Gletscherlawine an der Altels, Zurich Naturf. Gesellsch. Neujahrsbl. 1896.) About four and a half million cubic meters of ice slid down an incline some four kilometers long, descending from 3,200 to 1,900 meters above sea level. Gathering about a million cubic meters of rock waste on the way, the gliding mass ran across the valley floor, dashing far up the opposite slope and falling back again, like a wave from a cliff. Finally settling, the debris occupied a square kilometer of surface to an average depth of five meters. A bench on the path of the sliding ice two hundred meters above the valley caused it to spring forward, like a boy's sled passing a 'hump' in his coast, for a time clear from the ground; then falling, the air beneath it was violently driven out to either side, bearing fragments of ice and stones and overturning trees for several hundred meters laterally and forwards, and thus nearly doubling the area afflicted. As in all Heim's work, the pictures gain great value from being drawn and lithographed by his own hand. One of the photographs represents the genial Zurich professor standing on the ice conglomerate.

INTERGLACIAL VALLEYS IN FRANCE.

MARCELLIN BOULE has recently made an interesting communication to the French Academy on the older and younger—pliocene and quaternary—glaciation of Auvergne (Comptes Rendus, December 2, 1895), from which it appears that the valleys of the elevated plateau of central France were excavated during a nonglacial interval. The upland bears extensive deposits of morainic material with scratched stones of all sizes and numerous *roches moutonnées*, implying an extensive glaciation. Beneath this upland, valleys are trenched to a depth, two, or even three hundred meters. In the valleys lie the moraines of local glaciers, to which reference has frequently been made by various observers.

MISCELLANEOUS.

Appalachia for January contains well illustrated narratives of ascents in the Canadian and Montana Rockies, and the California Sierra. The photographs by the Topographical Survey of Canada exhibit the great extent of lofty mountainous country in which deep valleys are dissected.

THE *National Geographic Magazine* (now issued monthly) for January, February and March contains descriptive articles on Russia by G. G. Hubbard, Venezuela by W. E. Curtis, Arctic exploration by S. Jackson, A. W. Greely and W. H. Dall, the Panama and Nicaragua canals by R. T. Hill and A. W. Greely, Tehuantepec ship railway by E. W. Corthell, the submarine cables of the world by G. Herrle, and the survey of Indian Territory by H. Gannett. Geographic literature and notes are briefly treated in each number.

AN abstract of explorations by Obruchef in central Asia is given in the *Scottish Geographical Magazine* for February. It emphasizes the mountainous character of much of the desert of Gobi, which was treated as a plain in older descriptions. "A marked peculiarity of many chains in central Asia is that they stand on high broad pedestals insensibly sloping down to the low central parts of the depressions." This is probably an incorrect interpretation of ranges nearly buried in alluvial wash.

THE same journal for March gives a sketch of British Guiana, by Chalmers, briefly characterizing the coastal plain, the inner highlands and their mountains, and the falls of the rivers in their descent from the higher to the lower district. Roraima and Kailteur are outlined.

VAUGHAN'S journeys in Persia are narrated in the London *Geographical Journal* for January and February. Special account is given of the Dasht-i-Kavir, or Great Salt desert, 360 miles east–west by 150 north–south, with a central depression one or two thousand feet below its margin, and including a great salt bed 440 square miles in area.

THE same journal for February has a paper on the Japanese Alps by W. Weston, speaking highly of their picturesque scenery. They consist of a backbone of granitic rocks, through or over which vast quantities of volcanic rocks have been poured.

W. M. DAVIS.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

MR. WILLIAM I. HORNADAY, formerly of the National Museum, has been appointed Director of the proposed Zoölogical Park in New York. He is eminently qualified for the position by his extensive knowledge of zoölogy, his ability as an untechnical writer upon travel and natural history, and especially by his experience in connection with the establishment of the National Zoölogical Park at Washington. He enters upon his duties immediately and will first consider and report to the Executive Committee upon the difficult question of location of the Park. At the last meeting of the Society the three first honorary members were elected as follows: Sir William H. Flower, Director of the British Museum of Natural History, President of the London Zoölogical Society; Prof. Alexander Agassiz, of the Museum of Comparative Zoölogy, and Prof. J. A. Allen, of the American Museum of Natural History.

THE first session of the Bahama Biological Station under the direction of Prof. Charles L. Edwards, University of Cincinnati, was held during the summer of 1893, at Bimini Islands, Bahamas. For the coming season it has been decided to locate the laboratory at Biscayne Bay, Florida, in the latitude of the Bimini Islands, and just across the Gulf Stream. Here is found the same equable climate, clear water and sub-tropical fauna and flora, for which the Bahamas are famous. An all-rail route of two days, at excursion rates, gives the more accessible Florida location a decided advantage. The Station is open to a limited number of investigators, teachers and students in biology. The session will begin Monday, June 22, 1896, and continue six weeks. The course of instruction consists of lectures, dissection and microscopic work in the laboratory, with observation of the organisms in natural environment. In order to supply students, or institutions at a distance, with materials for practical work, a collecting department has been established. Orders for laboratory material, or applications for admission to the Bahama Station, should be made to the director before June 1st.

THE bill appropriating $500,000 for an additional wing for the American Museum of Natural History has been signed by Governor Morton. This, in addition to the wing now in course of construction, and the wing recently opened to the public, will make the Museum one of the finest in the world. The new wing will be in the form of an 'L' completing the 77th street front and extending a short distance along Central Park.

A PROVISIONAL Committee has been formed in England to promote the International Memorial to Pasteur. The Executive Committee consists of Sir Joseph Lister, Sir John Evans, Sir Henry Roscoe, Dr. Thorne Thorne and Prof. Percy Frankland (Honorary Secretary).

AT the annual meeting of the American Philosophical Society, at Philadelphia, on May 1st, the meeting will be devoted to a discussion of 'Evolution,' in which Professors Cope, Minot and Bailey will take part.

THE following is the program of lectures before the National Geographical Society for April and May: April 6 (sixth Monday afternoon), 'From Sitka to the Sunset,' Mr. Marcus Baker, of the U. S. Geological Survey; April 10 (special Friday afternoon), 'Cuba as Seen by a War Correspondent,' Capt. Wm. F. Mannix; April 13 (seventh Monday afternoon), 'A Journey in the Interior of Alaska, Prof. I. C. Russell, of the University of Michigan; April 17, 'The Geography, Scenery and Resources of Idaho,' Hon. Fred E. Dubois, U. S. Senate; April 24, 'Progress of Africa since 1888, with Special Reference to South Africa and Abyssinia,' Hon. Gardiner G. Hubbard; May 8, 'Geography as Illustrated by Precious Stones,' Mr. George F. Kunz, of Tiffany & Co., New York. The total membership of the Society is now 1,374, consisting of eleven honorary, 1,070 active and 293 corresponding members.

THE death is announced of M. Julius Belleville, an eminent French inventor.

THE bill before the House of Representatives adopting the metric system of weights and measures as legal standards in the United States has been referred back to the committee. The Bill was ordered to a third reading by a vote of 119 to 116, but this vote was afterwards reconsidered.

DR. WILKES has been elected President of the Royal College of Physicians, London, the final vote standing 114 for Dr. Wilkes and 32 for Sir William Broadbent.

MR. HENDRICK R. HOLDEN has been appointed New York State Fish, Game and Forestry commissioner.

THE Huxley Memorial Committee will be glad to receive designs for a medal to be awarded by the Royal College of Science, London. Further particulars will be furnished on application, which must be sent in before May 1st to the honorary secretary of the Huxley Memorial Committee, Prof. G. B. Howes, Royal College of Science, South Kensington, S. W.

WE learn from *Nature* that Prof. Wyndham R. Dunstan has been appointed Director of the Scientific Department of the Imperial Institute, which has hitherto been under the direction of Sir Frederick Abel. Prof. N. A. Moor of the Elphinstone College, Bombay, has been selected for the post of Director of the Government Observations at Colaba, in succession to the late Mr. Charles Chambers.

ARRANGEMENTS are being made for a tour abroad by a hundred American physicians, who will visit during the coming summer the principal health resorts of Europe. It is expected that various courtesies will be shown them at the places visited.

THE fourth International Hydrological, Climatological and Geological Congress will be held at Clermont-Ferraud at the end of September, 1896.

A LETTER signed by Prof. John Caird, Principal and Vice-Chancellor of the University of Glasgow and Sir James Bell, Lord Provost of Glasgow, has been sent to various universities and learned and scientific societies, inviting them to send representatives to the jubilee of Lord Kelvin, which will be held at Glasgow on the 15th and 16th of June next.

AT a meeting of the fellows of the Royal Botanic Society, in London, on March 28th, it was stated that since the gardens have been open to the public on Mondays and Saturdays there has been a good attendance, a total of 6,000 persons having attended on eleven of the Mondays. It had been claimed that fellows would resign if the grounds were open to the public, but instead of that the roll of fellows had been greatly increased. The plan of having promenade concerts in the garden has not been favored by the Council, but will be again considered.

IT is stated that Huxley's library is now offered for sale.

REUTER'S Agency states that the Windward, of the Jackson-Harmsworth expedition will leave again for the Arctic seas early in June. The Windward will carry a budget of letters for Dr. Nansen, on the chance of falling in with him north of Franz Josef Land. More members will be sent out to recruit the Jackson-Harmsworth expedition. The Windward will call at Archangel. The organizers of the expedition are in communication with Mr. Andrée, the projector of the balloon voyage towards the Pole, who, in view of the possibility of his balloon drifting in a southeasterly direction, is receiving full particulars of the depots which have been established by Mr. Jackson.

AT a recent meeting of the British Astronomical Society, a number of papers were read under the title of 'Eclipse Suggestions.' According to the report in the London *Times* Mr. J. Lunt suggested a method of determining the general brightness of the corona. The principle of the method was to photograph a small 'window' through which the coronal light was streaming, and the squares of which varied from clear glass through various degrees of opacity, such that the coronal light was able to penetrate with actinic effect through a square of medium opacity in the time at the observer's disposal during totality. Mr. A. C. D. Crommelin read a note on 'Some of the attendant phenomena of total solar eclipses.' The President also contributed some suggestions, his subject being 'Camera work.' He said that two lessons were suggested by the Californian experiences—namely, the need for mounting the camera very solidly, and the unwisdom of attempting too many photographs. Mr. A. Fowler read a paper and showed twelve lantern slides illustrative of the observations that might be made with a pocket eclipse spectroscope.

D. APPLETON & CO.'s spring announcements include *The Warfare of Science With Theology in Christendom*, in two volumes, by Andrew D. White; *Genius and Degeneration*, by Dr. William Hirsch; *Our Juvenile Offenders*, a new volume in the Criminology Series, by W. Douglas Morrison; *The Intellectual and Moral Development of the Child*, by Gabriel Compayré, and *A B C of Sense-Perception*, by William J. Eckoff, new volumes in the International Educational Series; *Ice Work, Present and Past*, by T. G. Bonney, a new volume in the International Scientific Series; and *Familiar Trees*, by F. Schuyler Mathews.

HENRY HOLT & CO.'s announcements of scientific works include *Electricity*, by Prof. Charles A. Perkine, of the University of Tennessee, and *A Problem Book in Elementary Chemistry*, by E. Dana Pierce, of the Hotchkiss School, Lakeville, Connecticut. The same publishers will add at once to their German Texts Eckstein's *Preisgekrönt*, edited by Prof. Charles Bundy Wilson, of the University of Iowa.

THE experiment about to be made at London of using sea water for watering the streets, flushing the sewers and other purposes will be watched with much interest in America. The Croton system supplying New York City is now being enlarged at much expense, and the additional supply is needed only for a short time during the year when sea water would be of course available. In addition to the possible economy it is urged that salt water will keep the roads and sewers much cleaner and more wholesome.

THE French Admiralty and a large number of railways and other corporations have adopted the metric system of screw threads recommended by *La Societé d'Encouragement pour l'Industrie Nationale*, of Paris. It is proposed to consider the subject at an international conference at Berne, where it is probable that the new system will be adopted, and in this case the Whitworth system would soon be superseded.

The British Medical Journal states that a water famine is threatened in London. In 1895 the total amount of rain measured at the Royal Observatory, Greenwich, was only 19.73 inches, against an average of 25.06 inches. This deficiency is still in progress in the present year. In February the total rainfall at Greenwich was only 23 per cent. of the average for the month, and at Paris only 16 per cent. During January and February together the value was as low as 65 per cent. short of the mean at Paris, while in London the deficiency was 68 per cent. The rainfall of 1896 in London has so far, in fact, amounted to less than one-third of the average.

IN a paper presented before the Paris Academy on March 23d, MM. le Prince Galitzine and A. le Carnojitzky claim that they have been able to polarize the X-rays by means of tourmalines. Lord Blythswood reported to the Royal Society on March 19th that he had been able to reflect the rays. The most perfect photographs hitherto taken by means of the Röntgen rays are produced in recent issues of the *British Medical Journal* and the *Lancet*, one of a monkey and one of an infant three months old; not only is the skeleton of a child shown with great distinctness, but some of the soft parts are clearly outlined.

PROF. J. C. EWART, of the University of Edinburgh, has undertaken an extended series of experiments upon telegony. He has a mare in foal by a zebra and a zebra mare in foal by a zebra stallion, and has arranged a number of other crosses in which the paternal and maternal characteristics are strong but less easily recognizable than in the above cases. Breeders thoroughly believe in telegony, or the transmission of the influence of a previous sire. A number of apparently authentic cases have been cited besides the famous one of Lord Morton's mare, but none that fully satisfy the most critical. The matter of transmission of characteristics from a previous sire in such an important one that it requires fresh verification, and Prof. Ewart's experiments will be watched with interest.

IN an editorial comment entitled 'The Taming of the Shrews' on the recent monographs by Dr. Merriam and Mr. Miller, *Natural Science* remarks: "In looking through these publications the conviction is forced upon one that 'they know how to do things in America,' and one wonders what work will be left for the poor fellows of the next generation. So far as North America is concerned, at any rate, there will be no new species to discover nor any work to be done in unravelling synonymy, for this is all done so thoroughly by the writers of these monographs. They know, too, how to print books in America; in this, as in their other government publications, both the paper and type are all that can be desired, and might well be commended to the notice of the 'Printers to the Queen's most excellent Majesty.' "

Appleton's Popular Science Monthly for April contains the Presidential address by Surgeon-General George M. Sternberg before the Biological Society of Washington on the 'Practical Results of Bacteriological Researches,' an article on the X-rays by Prof. Trowbridge, a continuation of the articles by Mr. Herbert Spencer, Prof. Ripley and Prof. Newbold, and other articles of interest, including a sketch of Benjamin Smith Barton, with a portrait.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Calendar of the University of Michigan for 1896–97 shows the following attendance:

Department of Literature, Science and the Arts	1204
" of Engineering	331
" of Medicine and Surgery	452
" of Law	675
School of Pharmacy	83

Homœopathic Medical College	27
College of Dental Surgery	189
	2961
Deduct for students enrolled in more than one department	44
	2917
Students in Summer School, 1895	97
Total	3014

The number of instructors is 160. The average annual fees (including laboratory fees) are about $50.00 per student.

MR. JOSEPH FIELD has given Mount Holyoke College $6,000 to found a scholarship in memory of his mother. The Catholic University of Washington has received $5,000 by the will of Mr. Bryant Lawrence.

DR. H. F. REID, late professor in the Case School of Applied Sciences, at Cleveland, O., has been made associate professor of geological physics in Johns Hopkins University.

THE accounts of the Cambridge University chest, as distinguished from the general University fund for the year 1895, shows that the total receipts were £39,681, 18s. 11d., and the total expenditures, £40,067, 6s. 8d. This sum includes £670 for the Observatory, £1,024, 7s. 7d. for the Botanic Garden, £4,550 for museums and lecture-room maintenance and £4,000 for the library.

THE French Chamber of Deputies has passed unanimously a bill giving the various French faculties the titles and privileges of universities. This would establish universities at the following places: Paris, Dijon, Lyons, Bordeaux, Montpellier, Lille, Toulouse, Nancy, Rennes, Aix, Poitiers, Caen and Grenoble. It is stated that there are now 24,000 students attending these faculties and that they receive annual subsidies from the government amounting to about $2,800,000.

THE Electro-technical Institute of Darmstadt has received about $100,000 from the government for the purchase of new ground and for the enlargement of the buildings.

WE learn from the *Naturwissenschaftliche Rundschau* that Dr. Julius Bauschinger, of the observatory at Munich, has been appointed as full professor of astronomy in the University of Berlin. Dr. H. W. Bakhuis Rosebom has been made professor of chemistry at the University of Amsterdam, and Dr. A. Bistrzycki has been called to the professorship of analytical and technical chemistry in the University of Freiburg, in Switzerland.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

EDITOR OF SCIENCE: Your correspondent in the last number of SCIENCE (pages 513–514), in making comments about my last article on 'Certitudes and Illusions' (pages 426–433), asks four pertinent questions, all of which were definitely answered in the article, but which are worthy of restatement in other terms. These questions are as follows:

First.—What is motion?

Motion is change of position. In the change of position two elements are involved, the speed of the change of position and the path of the change of position. We may reason about the speed or we may reason about the path, but these two elements must not be confounded, lest they lead to illusion. This is a concrete world, and there is no speed without path and no path without speed; we may reason abstractly, but the abstraction must be complete.

Second.—What is rest?

Rest is a mode of motion. I have defined the use of the terms particle and body, and the definitions need not here be repeated. In nature the ultimate particle is combined in a hierarchy of bodies, the atom is probably combined of particles, the molecule is known to be combined of particles, the molecules are combined into molar bodies, the molar bodies are combined in the earth, the earth is combined in the solar system. The particle has the motion of all of these bodies. If any body has a motion differentiated from the motion of any other body in the same rank of the hierarchy in such manner that the body as a unit has a motion distinct from the bodily motion of the next higher unit, that motion may be accelerated positively or negatively, but this can be done only by deflecting its motions in all other bodies of the hierarchy. Let us take the case of molar motion. The molar body partakes of the motion of the earth and the solar system, and also partakes of the motion of its molecules, atoms and particles; a motion of the molar body, as a differentiated motion of that molar body, is a deflection of the motions in all the other bodies of the hierarchy, but if these other motions be not deflected, as a motion of the molar body differentiated from the other molar bodies, it is at rest. In this case, therefore, rest is the absence of motion in a molar body which differentiates it from other molar bodies in respect to motion. Rest, then, in molar motion is stellar motion and molecular motion. Rest is the motion of a body in its superior and inferior incorporation, undifferentiated from the motions of the bodies of its own rank in the hierarchy of incorporations.

Third.—If by 'motion as speed' is meant 'velocity,' and if by its 'persistence' is meant invariability of velocity, what possesses this invariability? bodies, molecules, particles, atoms? and in reference to what is the velocity constant?

So far as can be determined from research, speed is constant in the ultimate particle, but the speed of the atom, if it is a compound body, is not constant. The speed of a molecule is not constant, and in general the speed of a body is not constant. The speed of a particle is constant in reference to itself at different times.

Fourth.—As a molecule is considered as a 'body' when reference is had to the atoms which compose it, can it have an 'invariable velocity' as a molecule and variable velocity as a 'body?'

The molecule has an invariable speed (or sum of speeds) in its ultimate particles, but as a molecule, or one composed of many, this one may have a variable speed. It will be recognized that I use the term speed rather than velocity, for the term velocity as it is used in physics does not mean speed. First, velocity is positive and negative; second, velocity is speed and trajectory. I have been trying to dispel the illusion which inheres in the double use of velocity when we fail to distinguish between speed and path. The abstraction must be perfect when we reason abstractly; when we reason concretely then abstractions must be combined. Two molar bodies in motion as such may collide with each other, both may be deflected, both may come to rest, or one may be deflected and the other come to rest. All of these cases are concretely explained as velocity in physics. Velocity is a concrete term, not an abstract term. The velocity of a body as speed and path is constant. When a particle or body moves in a straight line its speed and its velocity are the same, but when a particle or body moves in a deflected line the velocity is measured by its speed and the force by which it is deflected. The distinction between speed and deflection is well marked by some English physicists who speak of *spirt* and *shunt*. When we consider the rate of motion we consider speed, not velocity, and we may consider speed in every incorporation in which an ultimate particle is found, and its total speed is the sum of all its speeds.

Let me ask your correspondent to once more consider my definitions and demonstrations, freeing himself from the illusion that velocity is the same as speed, making a perfect abstraction of those things which we are considering abstractly and a perfect comprehension of those things which we are considering concretely.

Finally your correspondent says:

I cannot refrain from expressing a hope, however, that in addition to these answers, Major Powell will kindly furnish an explanation of what he means when he says that the transmission of light at the rate of 299,878,000 metres per second, furnishes an example of 'particle motion at a velocity so great that any observed molecular motion sinks into insignificance.'

This assures me that your correspondent was attentive to my language, and I wonder whether he detected some other misprints in my article. In the same paragraph I say: "The molecular motion of a cannon ball at its mouth is from 518 to 671 metres per second." Of course I should have said the *molar* motion of a cannon ball. If in these cases he will substitute molar for molecular he will understand what I intended. On reading the published article I discovered this and one or two other errors, which are probably due to my habit of dictation, but thought them hardly worth noticing, as I belived that every intelligent reader would discover the errors and correct them himself.

J. W. POWELL.

VIVISECTION.

EDITOR OF SCIENCE: I note with regret several errors in the report (SCIENCE, April 3d) of my paper on 'Vivisection; Its Objects and Results,' read before the Anthropological Society of Washington at its meeting on March 3d.

I shall only correct the one which first meets the eye and which makes me appear to have made a very ridiculous statement. The report commences as follows: "In the course of his paper Dr. Sternberg said that by dissection of dead plants and animals only can we determine the nature of their functions." The following quotation from my manuscript shows what I really said:

"By means of the experimental method the chemist has succeeded in analyzing air, earth and water, which were regarded by the ancients as elements, and has learned to manufacture in his laboratory, by synthetic processes, many of the complex organic substances found in nature. By experiment the physicist has demonstrated the persistence of force and the corelation of the various modes of motion known to us as heat, electricity, etc. He has learned to recognize the elements of the chemist in distant suns by means of the spectroscope and has recently shown us that certain ethereal vibrations may pass through wood and metal as light rays pass through glass.

"In like manner biologists and physicians have established the facts which constitute our knowledge of biology in all its branches. Used in its broadest sense, this term includes animal and vegetable physiology, animal and vegetable pathology, ætiology, morphology, embryology, psychology and sociology. Now, it is evident that all questions relating to these various branches of biological knowledge must be determined by the observation of *living* organisms and by experiments upon *living* plants and animals. To some extent the study of morphology and of pathology constitutes an exception to this general rule, inasmuch as these branches of biological science also call for the dissection of dead plants and animals. Our knowledge of animal and vegetable histology, of human anatomy and of the results of disease processes has been obtained in this way, and could not have been obtained in any other way. But *the dissection of dead plants and animals cannot determine the functions* of the various anatomical elements and organs revealed by such dissections, although aided by the microtome, differential staining methods, the microscope, etc."

GEO. M. STERNBERG.

WASHINGTON, D. C.

INSTINCT.

EDITOR OF SCIENCE: Prof. Lucas seems to me to have advanced this discussion on instinct by his reference to a letter in *Nature*, which appeared in Vol. 52, page 30. According to the writer, it is customary for the Asamese natives to 'teach' the young jungle fowls to peck.

If this be true, what then becomes of Prof. Morgan's distinction?

As a matter of fact, if one observes a good many chicks, he will find that a large proportion of the birds never peck without suggestion (the term 'teach' seems objectionable) from the hen or some substitute. The chief value of such facts grows out of their showing that instincts are never perfect and never of that type once believed in—the unalterable, inevitable and unvarying—like the rising and setting of the sun; and for such rigid notions the reports of some scientists are in part responsible. It sometimes happened that experimenters in biology, etc., omit the exceptions and report only 'good experiments,' so that a false view of the case must necessarily arise. Prof. Baldwin seems to adopt Prof. Morgan's views, for he refers to the observation that the chicks drank 'only after they had the taste of water by accident or by imitating the old fowl.' Granted—but they also peck only after *seeing* small objects under certain conditions, and there is no instinct that does not require some stimulus in the environment to bring it into action. The mechanism is ready, but it is useless without this stimulus.

If one knew but of those domestic chicks or those jungle chicks that peck only on seeing this act, one might speak of a certain imperfection in the instinct of pecking, as, if you will, in drinking; but what I must again object to is drawing radically different conclusions as to the nature of eating and drinking by chicks, and even building theories of evolution on them.

As I understand Prof. Cope is to reply to Prof. Baldwin's views on Consciousness and Evolution through the medium of the *American Naturalist*, I will only remark regarding his discussion in SCIENCE, p. 438, on Heredity and Instinct, that, while I find his views very interesting as illustrations of natural selection, the Lamarckian principle, the influence of environment, etc., they seem, in the main, to fall within the range of principles already recognized by the Darwinians and Lamarckians, though perhaps not adequately. But I fail to see that a single safe step can be taken in explaining evolution either in biology or psychology, if the effects of the environment and of use be ignored; indeed, Prof. Baldwin's very facts and illustrations are, to my mind, only comprehensible by the introduction of those factors; and why there should be such anxiety on the part of many to get rid of factors so obvious, and to substitute for them the biological fatalism and reasoning in a circle of Weismann, is a puzzle to me.

I trust Prof. Baldwin will not insist on coining many new terms, or favor their adoption as far as evolution is concerned. 'Social heredity' is about equivalent, is it not, to social environment, and the entire environment is one into which, as a rule, the animal is born, so why speak of 'social heredity?' Technicalities have their advantages, but they often conduce to mental myopia, and hamper the comprehension and progress of truth by binding it up in packages, so to speak—packages which all cannot readily undo. WESLEY MILLS.

McGILL UNIVERSITY.

FOOTGEAR.

EDITOR OF SCIENCE: Apropos of the heel quarters or heel bands on the feet of men shown on Mexican and Maya sculpture and pottery Dr. Fewkes calls my attention to the fact that among the Tusayan Indians an embroidered heel band is worn over the moccasins in all dances. In the statuary shown by Maudslay and other authors the footgear looks as though a man were wearing a gaiter from which the vamp or front had been cut away. In this view the supposed sole is the pedestal; what appears to be a stocking is the moccasin, and the heel quarter is the decorated ceremonial heel band fastened across the instep with lacings. O. T. MASON.

WASHINGTON, D. C.

SCIENTIFIC LITERATURE.

Greenland Icefields and Life in the North Atlantic, with a New Discussion of the Causes of the Ice Age. By G. FREDERICK WRIGHT, D. D., LL. D., F. G. S. A., author of the *Ice Age in North America*, etc., and WARREN UPHAM, A. M., F. G. S. A., late of the Geological Surveys of New Hampshire, Minnesota and the United States. With numerous maps and illustrations. New York, D. Appleton & Co. 1896. 12mo. pp. xv+407.

The immediate impulse to the preparation of this volume arose in connection with a trip to Greenland taken on the unfortunate steamer Miranda in 1894. It will be remembered that this steamship of eleven hundred tons' burden started out with the intention of reaching Peary's headquarters in Inglefield gulf, with a complement of fifty-one passengers. Ten days out she collided with an iceberg off Labrador and returned to St. Johns for repairs. After reaching Sukkertoppen, the largest Eskimo settlement in Greenland, the steamer ran upon a reef and received serious injuries, compelling her to stop again for repairs and to start homeward as soon as possible. In less than two days' time she foundered, and the passengers and crew were safely transferred to the schooner Rigel. The senior author had an excellent opportunity to study icebergs in their legitimate work of producing geological changes, and had nearly a fortnight's time to explore the edge of the ice sheet close to the Arctic circle.

The authors have improved their opportunities by giving in this book an interesting resumé of what is known respecting the glaciers, ice fields, explorations, icebergs in action, the plants, animals, the Eskimo and the early Norsemen of Greenland. Mr. Upham prepared the chapters upon the plants, animals, explorations, and the lessons taught by the Greenland phenomena in the elucidation of the Ice Age. Besides the text several excellent maps of

Greenland, Labrador and the whole northern regions were drawn by him; and he has restated his views respecting the causes of the cold.

Greenland has an area of 680,000 square miles, of which 575,000 are occupied by the ice sheet. On the east side the coast consists very largely of ice cliffs, while on the west there is a border of habitable land towards twenty miles in width for more than half its length, and numerous glaciers cross this belt, reaching the sea and discharging icebergs therein. The edge of the ice is usually from 1,500 to 2,000 feet above the sea, quite precipitous; and thence the ice surface gradually rises to the altitude of 8,000 to 9,000 feet on the watershed, the whole surface being inclined westerly, at first six and later two degrees, till the summit is reached and the slope becomes easterly. Hayes called the interior 'a vast frozen Sahara immeasurable to the human eye.' Near the boundary, because of the greater ablation, the surface is crevassed and rivers flow freely, occasionally plunging into the abysses. The great central region is the analogue of the *névé* fields or gathering ground of the ice.

Areas of considerable altitude uncovered by ice or snow and hence bare rock or earth capable of sustaining vegetation like the Alpine garden of the *Mer de Glace*, in Switzerland, are called *nunatakr* (singular *nunatak*) by the natives. This word supplies a needed place in our vocabulary, and is being extensively used by glacialists.

The most important inland expeditions were those of Dr. Hayes, in Lat. 78°, 1860; Nordenskiold, in 1881, Lat. 68°; Nansen, 1888, in Lat. 64°, and of Peary, 1892, Lat. 78° to 82°. The last two only went entirely across the island. Nansen found that the kryokonite, described by Nordenskiold, as cosmic dust was rather to be regarded as material blown by the winds from the coast. Peary's trip was of the most consequence, as it was the farthest north and practically two routes, as the return road lay a hundred miles nearer the pole.

The notices of processions of icebergs and flows help to the understanding of the effects produced by floating ice, which are liable to be depreciated in these days when the glacier is invoked as the great agent at work. The bergs off the Labrador coast constitute a stream one hundred miles wide and one thousand miles long, derived chiefly from the north part of Greenland. Numerous seals accompany them, finding the conditions favorable for procuring food and for rearing their young. Their number is given as hundreds of thousands. In their train follow the Arctic bear, fox and innumerable flocks of birds, all dependent ultimately upon the food which the seals secure from the sea. Their worst enemy is man, and as the number of hunters has increased, with weapons terribly destructive, the products are diminishing in amount, so that the late financial collapse of Newfoundland is partially due to the poor success of the sealers.

A more important stream of floating ice is that which starts in the frozen seas north of Siberia, passes by the pole, skirts the east coast of Greenland and partially turns to the northwest at Cape Farewell. This procession commences late in January, as seen in southern Greenland, and continues into September. Intermingled with the ice are pieces of floodwood, which furnish the Greenlanders with lumber and firewood. Sometimes logs sixty feet in length are drifted upon the shore. Rink conjectures that the annual gleanings upon the whole coast may amount to from eighty to one hundred and twenty cords, a small part of which passes 68° N. Lat. This wood seems to have grown upon the banks of rivers in Siberia, being coniferous, and thus is unlike that drifted to the shores of northern Europe by the Gulf Stream. Freshets carry the logs far out into the Arctic sea, where they are drawn into a slow but steady current, which first sets to the northward from the northern coast of Asia and from Spitzbergen, and then passing on southwards conducts the ice floes of that region along the eastern coast of Greenland. It is to this current that Nansen has committed himself, confidently expecting to be carried past the north pole. Mr. Upham's map shows very clearly this projected route from Bennett's island or from the gulf of the Ob across to Greenland.

The story is well told of the Tertiary warm temperate plants of Greenland, so allied to the similar remains found upon both continents as to necessitate the belief of an early land connection between Europe and America. The present flora, enumerated at 386 species by Lange, contains a slightly larger number of European than American species. Warming finds two botanical regions, of which the southern is characterized by the presence of the white birch, extending two degrees north from Cape Farewell, and contains many European types. The larger, or northern, region is more American in its facies, but the majority of the plants are circumpolar. Most authors have regarded this flora as of Scandinavian origin; but the suggestion is here made of the possibility of its being merely the wreck of the earlier Tertiary development. The Greenland flora is essentially that of the highest White Mountain summits.

All these and other details concerning the physical features of Greenland help us to imagine the condition of things over our northern regions in the ice age. Greenland must have had a greater development of ice in former times, since the present habitable strip of land is glaciated; but the authors believe it was milder there in the times of the early Norse settlements several hundred years ago. The débris in Greenland is principally transported in the lower part of the glaciers, whence it is possible to believe in a similar movement for the material of the drumlins and many boulders. The Greenland ice moves more rapidly than the Alaskan and Alpine glaciers, averaging about fifty feet daily. This may be due partly to the steeper slopes, which are from 100 to 200 feet per mile. Inclinations of fifty feet to the mile are necessary for vigorous movement; but a large part of the American ice did not possess surface slopes of more than twenty-five or thirty feet to the mile.

Attention is paid to the great elevatory movements of our continent upon both the Atlantic and Pacific coast, as well as on the Gulf of Mexico, which took place in pre-glacial times—from 2,000 to 3,000 feet in amount—and it is thought this uplift has been sufficient to develop the severe glacial climate. The astronomical theories, including the latest views of Croll, Wallace, Drayson, Becker, Sir Robert Ball and Sir John Evans, are weighed in the balance and found wanting in the comparison. The great uplift would have given rise to a high plateau climate with abundant snowfall and accumulation of an ice sheet, whose weight seems to have been a chief cause of the ensuing depression in the Champlain age.

The distribution of the till, more or less coincident with terminal moraines, allows of a classification into stages.

First came the culmination of the Lafayette uplift, which is regarded as Quaternary and therefore not to be esteemed as the equivalent of the Scanian or Norfolkian of Geikie, as they belong to the Pliocene. It includes the Albertan and Saskatchewan stages of G. M. Dawson. Next came the Kansan, Aftonian and Iowan stages, all of the four named being classified as the *Glacial* epoch proper. The second epoch is named the *Champlain*, being the time of melting and of subsidence, and is divided into the Champlain marine beds, the Wisconsin drift sheet indicating moderate reëlevation, the Warren glacial lake, the Toronto stage of temperate climate, the Iroquois lake and the St. Lawrence lake, overflowing through the Champlain basin into the Hudson river. The number of stages agrees exactly with those specified by Geikie for Europe, provided the Lafayette consist of two. The authors rank themselves as advocates of the unity of the glacial epoch. It is probable that the present diverse schools of glacialists will tend hereafter to a greater convergence than divergence. C. H. HITCHCOCK.

Hansen's Studies in Fermentation. Practical Studies in Fermentation, being contributions to the Life History of Micro-organisms. By EMIL CHRISTIAN HANSEN, PH. D., Professor and Director of the Carlsberg Physiological Laboratory, Copenhagen. Translated by ALEX. K. MILLER, PH. D., F. I. C., F. C. S., and Revised by the Author. E. & F. N. Spon, London and New York (12 Courtland St.), 1896. Pp. xiv+277. 8vo. Illustrations. Cloth.

The general features of Dr. Hansen's reform in the fermentative industries have long been known to every one who is interested in the scientific and practical features of applied mycology. They are known as new and important departures in regard to method and application, and as important factors in the evolution of great industries. Having been successfully outlined in Jörgensen's admirable text-book, 'Micro-organisms and Fermentation' (London, 1893), they are now presented to the public as exhaustively as necessary to the practitioner as well as to those who, without being zymotechnics *ex-professo*, need to become acquainted with the original work of Hansen.

The present volume 'treats,' as the author expresses himself, 'in the main, of the great questions of the circulation in nature of the alcoholic fungi, their relationship to the diseases of beer, the pure cultivation of yeast, and the employment of systematically selected species and races.'

Until the beginning of the last decennium the fermentation of beer, wine, etc., the souring of milk, and other procedures involving an employment of the vitality of micro-organisms, were carried out more or less at random. Pasteur taught us that if the fermentation in beerwort shall terminate in the formation of a fair product, no bacteria must be present in the yeast. Thus, Pasteur's 'pure yeast' refers to yeast free from bacteria. Hansen went further than this. Having discovered the scientific reasons why yeast is not constant with reference to its morphological and physiological peculiarities, he established the maxime, now generally accepted, that yeasts, as commonly used in breweries, are mixtures of cultivated and uncultivated species of *Saccharomyces*, and that most of the latter so-called 'wild' forms are 'disease'-producing, that is, give rise to fermentations unfavorable to both producers and consumers. They were found to cause—aside from certain bacteria which are known to impair the results of fermentations in the brewery —many of the symptoms which are familiar to brewers, such as bitter taste and disagreeable odor, lack of constancy in the product, and the like.

Hansen's studies resulted directly in a method by which it is in the power of any brewery to secure a uniform, good product. Systematically selected culture yeasts would, when introduced into the brewing establishments, be certain to yield uniform, good grades of beer.

The proper selection of races was facilitated by a new method of pure cultivation, allowing the observer to trace the development of cultures from individual well-defined cells.*

The successful introduction of *Hansen's* system into nearly all countries speaks eloquently for its merits.

The major part of the volume refers to the practical side of the question, but, as it is based upon new methods in the study of microscopic fungi, considerable space is devoted also to the botanical study of these, especially of the yeasts. Hence the appropriate sub-title noted above.

The indirect result of Hansen's work is a new departure in the dairy industry. Storch, of Copenhagen, applied the principle of selected species of organisms to the ripening of cream, and was followed by a number of able investigators, among whom is Professor Conn, of this country, who demonstrated the necessity of selecting such forms of the lactic acid bacteria as were found to produce an ideal ripening for rational dairying. In this manner improved grades of butter may be produced and maintained.

The publications of Wortmann and others show that the question of pure cultivation of wine yeasts is rapidly gaining in favor and influence with the German and French manufacturers of wines.

In distilleries the system has also been successfully adopted.

Hansen's late studies of the acetic *bacteria*† seem to indicate a rapidly advancing reform in the manufacture of vinegar, based upon the same principle as has been followed year after year by agriculturists throughout the world, namely, that pure seed secure a pure crop.

Space does not permit a recapitulation of the substantial volume before us. Yet it is evident that every one whose work in any respect touches upon fermentations will find it among those publications which must inevitably be consulted in all future work.

*This method was described exhaustively by the reviewer in the *American Monthly Microscopical Journal*, XV., 35—40, 1894; with plate.

† Comp. rend. d. trav. du laboratoire de Carlsberg III., 265–327, 1894. Ber. d. Deutschen Bot. Ges. XI., (69)–(73), 1893. See also Lafar; Centralbl. f. Bakt. u. Par XIII., 684–697, 1894; idem, zweite Abtheilung, I., 129–150; 1895.

The appearance of the book is in every way faultless. J. Christian Bay.

Iowa State Board of Health,

SCIENTIFIC JOURNALS.

THE AMERICAN GEOLOGIST, APRIL.

Apparent Anomalies of Stratification in the Postville Well: By Samuel Calvin. A recently bored well in northeastern Iowa shows a remarkable and unusual thickness of shaly material in the St. Peter Sandstone. Caverns are frequent in this unconsolidated and easily eroded sandstone, and the author suggests that in this case a cavern was formed in the St. Peter sandstone and it was afterward filled by descending waters with material from the shaly members of the overlying Trenton.

Englacial Drift: By W. O. Crosby. In the longest paper of this number, Prof. Crosby presents a very thorough discussion of the drift which was transported in the lower part of the thick Pleistocene ice sheets, comparing them with the Malaspina Glacier and with the present ice sheet of the interior of Greenland. To designate the drift so enclosed in glaciers and ice sheets, Chamberlin proposed the term englacial, but he supposes that this part was of small amount in comparison with the drift dragged and pushed along beneath the ice as its ground moraine. Crosby shows by the almost universally glaciated surface of the bedrocks beneath the drift, excepting near the borders of the drift-bearing areas, that the ice sheet gathered into its lower part all the preglacial residuary soil and alluvium, until the base of the ice, thickly charged with englacial drift, wore into the hard underlying rocks. With the return of a warm climate, during the Champlain epoch, causing the final recession and departure of the ice, Prof. Crosby thinks that the rapid surface melting was accompanied also by much melting of the base of the ice sheet, whereby much of the previously englacial drift was deposited as subglacial till. It becomes, therefore, difficult to discriminate the finally subglacial deposits from the portion of the drift which continued to be englacial until the surface melting or ablation at last exposed it as superglacial till. The origin of the modified drift, or stratified gravel, sand and clay, brought by streams of water from the drift-laden ice, Prof. Crosby ascribes in its larger part to subglacial drainage, rather than to the superglacial streams which Upham has regarded as the chief agency of derivation of these beds during the mainly rapid final retreat of the ice.

Further examination of the Fisher Meteorite: By N. H. Winchell. Further careful study of this interesting meteorite shows that it contains considerable glass, the mineral asmanite (tridymite), and very probably the mineral maskelynite.

Preliminary Notes on Studies of the Great Lakes made in 1895: By F. B. Taylor. The author states that his explorations and studies during 1895 lead him to doubt his former reference of the high shore lines about the upper great lakes of the St. Lawrence to marine submergence attending or following the close of the Ice Age, instead of which he now concludes that probably all these shores belonged to vast lakes held by the barrier of the waning ice sheet. He asserts, however, that the glacial Lake Warren, according to his exploration of its shores, was limited to the basin of Lake Erie and the southern part of the Huron basin, outflowing by the Pewano channel, southwest of Saginaw Bay, to the glacial Lake Michigan. The very high shores around Lake Superior and the northern part of Lake Huron and Georgian Bay, he attributes to the later Lake Algonquin, with outlet by a river flowing to the south and east along the present bed of Lake Erie.

In an editorial comment by Mr. Warren Upham, referring to Mr. Taylor's paper, it is suggested that only the highest beach which had been attributed to Lake Warren in the Erie basin may represent the Pewamo outlet, and that later stages of Lake Warren, flowing past Chicago to the Des Plaines and Illinois rivers, probably formed the Arkona and Forest or upper or lower Crittenden beaches, and the high shores of the Georgian Bay region, and also of Lake Superior, excepting those of its western part belonging to an earlier glacial lake.

THE MONIST, APRIL, 1896.

Prof. Mach describes a method of using Röntgen's X-rays for obtaining stereoscopic views of invisible objects. Two photographic shadow-pictures, say of a mouse, are obtained from two different points of view and stereoscopically combined into a solid phantom-picture, showing the skeleton, etc., in actual relief. This is simply a modification, by the use of the Röntgen rays, of Mach's old and well-known method of getting solid views of concealed anatomical structures, etc. Prof. Mach has also a few remarks to make on the physical character of the X-rays. The same subject is treated at length in a second article by Prof. Hermann Schubert, who gives an account of the methods successfully employed in the Hamburg State Laboratory. Two actinograms, one of a plaice with shells in its intestines, and one of a lady's hand, showing the position of a fragment of a needle, accompany this article.

In the third article Edward Atkinson discusses 'The Philosophy of Money.' A Polish philosopher, W. Lutoslawski, of Kazan, gives a brief sketch of the philosophy of Polish individualism.

The article 'From Animal to Man,' by Prof. Joseph Le Conte, is a contribution to comparative psychology. Considering successively speech, art, thought, imagination, consciousness and will, Prof. Le Conte tries to put his finger as nearly as he can 'on the dividing line where humanity emerges out of animality.' The abstraction of *self* from the facts of consciousness, he thinks, may be regarded as the consummation of humanity. 'The Dualistic Conception of Nature' is a contribution by Prof. J. Clark Murray, tracing the fortunes of dualistic notions in the history of philosophy and religion.

Prof. Kurd Lasswitz attacks a more difficult problem in 'Nature and the Individual Mind,' a metaphysical question of profound interest to psychologists and philosophers. Prof. Lasswitz seeks to show that there is no change of mode of existence when things physical become things mental; the difference is merely a difference of combination of elements. 'Objective and subjective are distinguished solely by their existential contents.' The opposition of object and subject is originally produced in and by knowledge, and nature itself is fashioned on lines parallel with the growth of knowledge. The doctrine of 'parallelism' which views physical and psychical phenomena as two modes of representation of the same synthesis is critically discussed, and we have also an interesting application of the psychological law of thresholds as marking the difference between nature and mind.

The last article is a discussion of the 'Nature of Pleasure and Pain,' by Dr. Paul Carus, with particular reference to the theory of Ribot. He thinks that the current views of pleasure and pain exhibit a neglect of the element of form or of the qualitative aspect of feeling. In his view the nature of a commotion is determined by its relation to the constitution and memory-structures of an organism. Pleasure is the satisfaction of a want originating in constitutional habits; pain is the felt evidence of an unsatisfied want or of any other disturbance. The author claims that this view will do away with all troublesome exceptions and inconsistencies of the old theories.

The number concludes with the usual literary correspondence and book reviews.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—258TH MEETING, SATURDAY, MARCH 21.

BARTON W. EVERMANN exhibited specimens of *Animals from an Artesian Well at San Marcos, Texas*. This well was sunk to obtain water for the station of the U. S. Fish Commission, and when the drill had reached a depth of 180 feet it dropped four feet, indicating the presence of a cavity. Although sunk much deeper, the well was finally closed up to a depth of 184 feet, an abundant supply of water being obtained at that level. The water flowing from the well contained a considerable number of crustaceans and a few batrachians, all blind and all new. The crustaceans comprised one species of shrimp, an isopod and a copepod. The batrachian, according to Dr. Stejneger, belonged to the Proteida, but was remarkable for the great length of its legs.

C. Hart Merriam spoke of the *Big Bears of North America*, giving the distinctive characters of the various species.

Leonhard Stejneger spoke on *The Use of*

Formalin in the Field, illustrating his remarks with examples of plants, insects, fishes and reptiles preserved in a mixture of formalin and water. The advantages claimed were cheapness, compactness, and the property of preserving specimens which could not be kept in alcohol, or could not be kept in such good condition.

Henry H. Dixon and J. Joly, of Trinity College, Dublin, summarized, by request, the results of their *Recent Researches on the Ascent of Sap in Trees*, making the deduction from an elaborate series of experiments that the movement was due to a state of tension in the sap induced by osmotic action and transpiration in the leaves. The chief necessary condition for maintaining a state of high tension (several atmospheres) is that the column of water shall not rupture, but to prevent rupture it is not necessary, as has been supposed, that the fluid shall contain no dissolved gas, but that the walls of the containing vessel be completely wet.

Under the title of *the Shade-tree Question from an Instinct Standpoint*, L. O. Howard presented a short communication upon the subject of the relative immunity from insects of different varieties of shade trees. He spoke of the extraordinary abundance of shade-tree insects in different Eastern cities during the summer of 1895, and exhibited specimens of the species which were principally abundant. He further said that in the selection of trees for shade sufficient account is not taken of their relative susceptibility to insect attack. He displayed a list drawn up a few years ago by Mr. Fernow for the Brooklyn authorities, in which the trees to be chosen were graded according to endurance, recuperative power, cleanliness, beauty and form, shade, duration of life period, rapidity of growth, and persistence; and in comparison with this list he rated the same trees according to their susceptibility to insect attack or their immunity from insect attack. The latter rating showed a somewhat different relative arrangement from the total rating derived from other qualities, and the speaker, while admitting the value of the total relative rating from so many important characteristics, expressed himself as of the opinion that in one or two cases, notably with the box elder, extraordinary susceptibility to insect attack renders them practically useless for shade-tree purposes, in spite of their many good qualities from other standpoints.

F. E. L. Beal read a paper on *the Food of the Cowbird, Molothrus ater*, giving the results of an examination of the contents of 366 stomachs of this species, collected in 20 States and the District of Columbia, and representing every month from March to December inclusive. The food was found to consist of about 28 per cent. of animal matter and 72 per cent. of vegetable. The animal food was composed almost exclusively of harmful insects and spiders. The vegetable food consists of 20 per cent. of grain (corn and oats), 51 per cent. of weed seeds and traces of fruit and a few other miscellaneous articles. As at least half of the grain eaten must have been waste, the conclusion is reached that in its food habits the cowbird does far more good than harm.

F. A. LUCAS,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE eighty-sixth regular meeting was held February 13, 1896, at the rooms of the 'Down-town Club,' and after the transaction of necessary business, was devoted to a lunch and social purposes, inaugurating the newly elected president, Dr. E. A. de Schweinitz. The following members also were elected: Messrs. Clinton P. Townsend, S. S. Voorhees and Dr. F. K. Cameron.

A special meeting was held February 21st to hear the Presidential address of the retiring President, Prof. Chas. E. Munroe, the subject being 'The Development of Smokeless Powder.' He first sought to show that the necessity for a high power, smokeless propellant had been created by the mechanical perfection to which ordinance had attained, and the precision of the weapons and instruments by which they were directed; that the possible production of such propellants was dependent upon the discovery of gun cotton, nitro-glycerine and certain nitro-substitution compounds and the improvements in their manufacture; that the possibility of producing uniform and reliable propellants was dependent on the invention of pressure gauges and velocimeters; and that the possibility of their economical production was dependent on the invention of mechanical mixers applied in other arts. In a historical resumé the recency of most of the inventions and discoveries was pointed out, and it was shown how large a proportion was due to American scientific men. The many smokeless powders manufactured or proposed were enumerated and classified into mixtures of different cellulose nitrates with oxidizing agents; mixtures of soluble or insoluble cellulose nitrates with nitro-glycerine; mixtures of cellulose nitrates with nitro-substitution compounds; and pure cellulose nitrate powders, and the methods of manufacture were briefly described.

The author's own experience in inventing a smokeless powder was then given. Recognizing at the outset the necessity for the closest approximation to absolute chemical and physical uniformity in a high-powered powder, and being familiar with the difficulty of securing such constancy in a physical mixture, he set about producing a powder from a carefully purified cellulose nitrate of the highest degree of nitration. This was the first and only attempt, so far as the lecturer was aware, to produce a powder which consisted of a single substance in its pure state.

The powder was manufactured at the Torpedo Station and proved at Indian Head by ordnance officers of the Navy. Secretary Tracy in his report (1892) says: "It became apparent to the Department, early in this administration, that unless it was content to fall behind the standard of military and naval progress abroad in respect to powder, it must take some steps to develop and to provide for the manufacture, in this country, of the new smokeless powder, from which extraordinary results had been obtained in Europe. With this object negotiations were at first attempted looking to the acquisition of the secret of its composition and manufacture. Finding itself unable to accomplish this, the Department turned its attention to the development of a similar product from independent investigation. The history of these investigations and of the successful work performed in this direction at the Torpedo Station has been recited in previous reports. It is a gratifying fact to be able to show that what we could not obtain through the assistance of others we succeeded in accomplishing ourselves, and that the results are considerably in advance of those hitherto obtained in foreign countries."

The conditions that smokeless powder should fulfill, and the tests prescribed by the lecturer were then set forth, and in closing he pointed out that the powder was now developed to a higher degree than the gun and that changes in the latter to render it more efficient were being considered by ordinance experts.

A. C. Peale,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON, MARCH 25, 1896.

Mr. Whitman Cross described the diorite of Ophir Loop, Colorado, and the remarkable inclusions contained in it. The diorite at this locality is a lateral arm of a stock which cuts up through Cretaceous sedimentary rocks and a bedded volcanic series of Tertiary andesites. The lateral offshoot from this stock is intruded as an irregular sheet between the Dakota Cretaceous and the upper Jurassic, reaching a thickness of 1,000 feet. In its lower portion it is locally very full of included rock fragments. These inclusions were described, and specimens were exhibited. They are interpreted as genetically connected with each other and with the diorite magma, which brought them to their present position.

The diorite is a variable rock, with augite and hornblende. The inclusions vary from feldspathic rocks, poor in dark silicates, to black amphibolites nearly free from feldspar. They are developed in granular and banded forms, and exhibit all manner of gradations in structure as well as in composition.

The study of these rocks led to the stated conclusions that quite local differentiation has gone on in the depths from which both diorite magma and inclusions came, and further, that a shearing movement of the differentiated magma, followed by consolidation, produced rocks greatly resembling many gneisses, amphibolites and schists, and especially those of the Archean complex. It was suggested that some gneisses and associated rocks of unexplained or assumed metamorphic origin may be primarily banded igneous rocks, which should be considered with their massive equivalents rather than with secondary schists of similar constitution.

Mr. H. W. Turner described the *Archean Gneiss in the Sierra Nevada.* The western part of Nevada was thought by the geologists of the 40th Parallel Survey to be an Archean area which, during Paleozoic time was a land mass, since there are no known Paleozoic sediments resting on it. It was supposed that Archean rocks existed in the Sierra Nevada, although the Jurassic age of the hornblendic granites of that range, as stated by Whitney, was accepted by the 40th Parallel Survey geologists.

An area of such rocks is believed to exist in the central part of the range, and is well exposed in the canyon of the north fork of the Mokelumne River and its branches. The rocks are chiefly gneisses with which are associated a granite which differs from the Jurassic granite of the range in containing much potash feldspar, and no hornblende, or very little. This granite is indistinguishable from some of the Archean granite of the Fortieth Parallel survey collections. The gneisses vary much in composition, some of them being made up chiefly of plagioclase, monoclinic pyroxene and biotite; another type is composed of plagioclase, hornblende and biotite; others carry quartz, and correspond nearly to a quartz-mica-diorite in composition. Titanite, zircon, apatite and pyrrhotite are among the accessory minerals. Some of the titanites exhibit a pleoöchrism, like that found by Lacroix to be characteristic of that mineral in pyroxene-gneisses. Certain light colored bands containing garnet, quartz and a mineral resembling wollastonite, may represent original limestone lenses, or may be regarded as vein deposits. One stratum, supposed to be a quartzite in the field, contains much pyroxene between interlocking quartz grains, and also numerous zircons. By far the greater part of the area is made up of the plagioclase-hornblende-biotite gneiss. The contact of the series with the large mass of hornblendic granite lying to the east is sharp. Apophyses of the hornblendic (Jurassic?) granite extend into the gneiss and older granite as dikes, and there are clear cut inclusions of the gneiss in the late granite. All of the rocks composing this Archean complex are thoroughly crystalline, and there is at present no positive evidence that any portion of the mass represents original sediments. The area has a maximum diameter of about nine miles. On the west it is in contact with the great area of Paleozoic sediments of the Gold Belt of the Sierra Nevada. Its relation to this Paleozoic series has not been made out.

NATIONAL GEOGRAPHIC SOCIETY.

At the regular technical meeting of this Society held in Washington, D. C., March 20, Mr. Gilbert Thompson explained and advocated the use of geodetic control lines in geographic work as supplementary to primary triangulation, when such lines are measured with care and latitude and longitude determinations made, etc. Following him, Mr. N. H. Darton read a paper on the 'Physiographic Development of the District of Columbia Region.' He outlined the geologic history of the river from early Cretaceous time, mainly in its bearing on the cycles of development. The present configuration is the product of sculpturing and deposition in Pleistocene times, but buried beneath the various deposits there is a succession of older land surfaces. The earliest recognizable surface is the floor of crystalline rock on which the Potomac formation was deposited. This is exposed in many points in the vicinity of Washington and it is seen to be a relatively smooth peneplain surface, which originally sloped very gently to the east and southeast. Other similar plane surfaces were eroded in the uplifts separating the several later Cretaceous, Eocene, and Neocene formations. These were widely extended base levelings, which were part of the general Tertiary planing of the Piedmont region. The present topography began with the uplift of the Lafayette, which amounted to about 120 feet. As the land rose the Potomac river was born, with its seaward course deflected by shoals on the Lafayette surface. The minor drainage was developed with approximately its present outlines, cut more or less deeply. Then with slight submergence with deposition, in which the early Columbia formation was spread over the floor of the wide river trough, and up the lateral valleys.

Then followed emergence, in which the early Columbia deposits were trenched and a wide terraced inner valley cut by the river. The widening did not progress as far as in the pre-Columbia period and wide areas of earlier Columbia terrace remained, at altitudes averaging 200 feet. Next came submergence, in which the later Columbia was laid down, and then followed a widespread moderate uplift in which this formation was trenched to a few yards before the present tide level. The next epoch is the present, in which the land is sinking; tide water extends far inland and it is encroaching gradually. The paper was illustrated by many slides from photographs of maps, diagrams, topographical feature and formation.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, April 6th, forty persons present, Prof. C. R. Sanger spoke on the commercial synthesis of acetylene, illustrating the flame procurable from this gas when burned with a proper proportion of air.

Prof. Sanger also presented the results of a preliminary biological and chemical examination into the ice supply of St. Louis, and exhibited a device for melting ice in such examinations without danger of contamination from atmospheric ammonia, etc.

The Secretary presented for publication, by title, a paper by Mr. Charles Robertson, entitled 'Flowers and Insects.'

Mr. William H. Roever presented a paper on the geometry of the lines of force from an electrified body, in which it was shown that (a) the curve representing a line of force proceeding from a system consisting of two parallel electrified lines, is the locus of the intersection of two straight lines, rotating in the same plane about these two parallel lines as axes with uniform but different angular velocities; (b) the curve representing a line of force proceeding from a system consisting of two electrified points is the locus of the intersection of two straight lines, rotating, in the same plane about parallel axes passing through those points in such a manner that the versines of their angles of inclination to the plane of the axes change at uniform but different rates.

WILLIAM TRELEASE,
Recording Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

BY the courtesy of the Massachusetts Institute of Technology the Society held its general meeting of March 18th in the physical lecture room of the Institute. Four hundred persons present. Prof. Charles R. Cross spoke of the X-rays, discussing the subject from an historical standpoint. He illustrated the phenomena connected with the disruptive discharges of electricity across an air space, across a space wherein there is little air, and in a tube in which a nearly perfect vacuum is maintained. The experiments and theories of Crookes, Herz and Lenard were reviewed; the distinctive characters of the X-rays, and the experiments of Röntgen described. The fluorescence of certain substances, such as platino-cyanide of barium, a marked peculiarity of the X-rays, was shown by illuminating a Crookes tube placed in a light-tight box; the rays passing through sheets of vulcanite and aluminum caused a prepared slip of platino-cyanide of barium to glow with a soft phosphorescent light. The work of various experimenters upon photographic plates and upon electrified substances was described in detail. Experiments to show the effect of the X-rays upon Bacteria, while not final, point to the conclusion that the Bacteria are not killed.

SAMUEL HENSHAW,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

March 31.—A paper under the following title was presented for publication: 'Dr. Collet on the morphology of the cranium and the auricular openings in the North European species of the family Strigidæ; to which is added some recent opinions upon the systematic position of the Owls,' by R. W. Shufeldt.

Prof. Henry A. Pilsbry called attention to a fine collection of barnacles obtained from the bottom of a vessel recently returned from a voyage to Hong Kong from San Francisco and back by way of Java and India. *Balanus tintinabulum* was the commonest of the species represented; the varieties *zebra* and *spinosus*, although growing under identical conditions, retained their individuality perfectly.

The question of the constancy of varietal characters was debated by Messrs. Sharp, Pilsbry and Heilprin.

Mr. Pilsbry also described a specimen of *Pugnus parvus*, a Ringiculate mollusk. The species is involute, a unique character, none of the fossil forms of the family possessing it. He also described a Central American Melanian under the name *Pachycheilus Dalli*. It is distinguished by a remarkable double sinuation of the outer lip which has a deep and wide Pleurotonoid sinus above and a rounded, projecting lobe in the middle, below which it is again retracted.

On the nomination of the Entomological Section, Dr. Henry Skinner was elected Professor in the Department of Insecta.

In response to an invitation from the Committee having charge of the celebration of the fiftieth year of Lord Kelvin's tenure of office as Professor of Natural Philosophy in the University of Glasgow, General Isaac Jones Wistar was appointed to represent the Academy on the occasion.

Entomological Section, Dr. Henry Skinner, Recorder, March 25.—Dr. Geo. H. Horn made a communication regarding the synomymy of the Elateridæ. He specially described the prosternum of *Ludius*. A Lower California form had the prosternum of different shape from that of other members of the genus, the mesosternum being more protuberant. It will probably be referred to *Probothrium*.

Mr. Chas. S. Welles exhibited specimens of the larva of *Harrisimemna trisignata*. When full grown they bore into wood preparatory to changing into crysalids.

A paper was read entitled 'The breeding habits of *Periplaneta orientalis*,' by C. Few Seiss. Three females deposited twenty-five egg cases. Each of these contained sixteen eggs, so that a new generation of four hundred cockroaches was represented by the deposit. The first of these egg cases were dropped May 5 and 14, 1895, and were hatched November 9th. In most cases the deposits were dropped with no attempt at concealment, although in a few instances they were placed in little trenches made by the insect and then covered up. The development of the capsules was described. The young probably receive no maternal care or protection.

Mr. Lancaster Thomas exhibited an improved form of insect net frame made of a continuous piece of rounded aluminum wire.

Mr. Westcott suggested linoleum as a substitute for cork in the arrangement of insects. Dr. Henry Skinner called attention to a fungus, *Polyporus betulinus*, which might be used for the same purpose with advantage.

Mr. Wm. J. Fox stated that about ninety species of Hymenoptera, six of which were perhaps new to science, were included in the collection of insects brought by Dr. A. Donaldson Smith from western Somali Land, Africa.

EDWARD J. NOLAN,
Recording Secretary.

NEW BOOKS.

Text-book of Comparative Anatomy, Part II. ARNOLD LANG; translated by Henry M. Bernard and Matilda Bernard. London and New York, Macmillan & Co. 1896. Pp. xvi+618. $5.50.

Memoirs of Frederick A. P. Barnard. JOHN FULTON. New York and London, Columbia University Press, Macmillian & Co. 1896. Pp. xii+485. $4.00.

Water Supply. WILLIAM P. MASON. New York, John Wiley & Sons. London, Chapman & Hall, Ltd. 1896. Pp. iv+504.

A Dictionary of the Names of Minerals. ALBERT HUNTINGTON CHESTER. New York, John Wiley & Sons. London, Chapman & Hall, Ltd. 1896. Pp. xv+320.

Geschichte der Explosivstoffe. S. J. ROMOCKI. Volumes 1 and 2. Berlin, Robert Oppenheimer. 1895, 1896. Pp. vi+394, xiv+324. M 12.

Twenty-first Annual Report of the Secretary of the State Board of Health of Michigan. Lansing, Robert Smith & Co. 1895. Pp. cxxiv +444.

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SCIENCE

FRIDAY, APRIL 24, 1896.

CONTENTS:

*RELATIONS OF GEOLOGIC SCIENCE TO EDUCATION.**

INTRODUCTION.

THE custom has been established which requires the retiring President of this Society, as other societies which have for their purpose the advancement of science, to set forth his views concerning matters related to the interests which the association seeks to promote. This custom evidently rests on the reasonable presumption that the officer during his term of service has been led by his duties to consider how the cause which he represents may be promoted, how its store of truth may be enlarged, and in what manner it may best be made to serve the interests of mankind. This task may be essayed either by a survey of the work which has recently been accomplished in the science, with appropriate comment on the trends and results of the endeavors, or the essayist may restrict his undertaking to some one portion of the field with which he is conversant in the hope that he may be able to present the fruits of his own labors in a way which is likely to be profitable to others. For various reasons I have chosen the latter of these alternatives and have taken for my subject the relations of geological science to education. Under this title I shall not only include those questions

* Annual Address by the President, N. S. Shaler, Read before the Geological Society of America, December 27, 1895.

which pertain to pedagogy, but certain larger aspects of the matter which relate to the needs of society, both from the moral and the economic point of view.

RELATIONSHIP OF TEACHING AND RESEARCH DEFINED.

I have been in good part led to take up this subject for the reasons that the title itself is a protest against the modern notion that the work of research should be separated from that of teaching; that natural inquiry should be released from the ancient and profitable connection with education, which in my opinion has advanced and ennobled both these branches of learning. Those who seek to have inquiry endowed are led to the endeavor by a true sense of the importance of the tasks with which the path-seekers in the fields of nature have to deal. They are, moreover, guided to their object by the motive which leads to the division of labor in all work which men do, whether in economics or in pure learning. Undoubtedly a certain kind of success would attend the complete separation of the students of phenomena from those whose business it is to impart knowledge; but there are gains which, though immediate, are not desirable, for the reason that they entail in the long run serious losses. It may well be apprehended that the definite separation of the inquirers in any science from those who are to teach the learning would result, on the one hand, in isolation of the men of the laboratory from the life of their time, and on the other, in a degradation of the instruction to a level where it would become mere formal tutoring, destitute of the penetrating spirit which gives value to scientific thought.

It seems to me that the explorer, if he be animated by the true spirit of his class, finds himself seeking for undiscovered realms, not for personal gains, nor, indeed, merely to add to the store of things known, but always with reference to the enlargement of mankind. His motive is in the highest sense that of the teacher; he limits his opportunities of personal culture if he denies himself the chance of communicating his gains to the youth of his time. It may be held that the investigator has his means of teaching through the press and the learned societies, but I need not tell my brethren of the craft that the opportunities of sympathetic contact with his fellow men which are thus to be had are very limited; that they are quite insufficient to satisfy the natural desire of an ardent student of nature for relations with the life about him. The only way in which a really wholesome situation can be found for the naturalist in any of the realms of nature is to link his work with the tasks of education.

Viewed from the point of view of the student of science, who has to catch the spirit of inquiry from the word of the master if he is to win it at all, we see that the teaching function of the inquirer is of the utmost importance to his science. We all recognize and deplore the evils which arise from the fact that young people have to be introduced to most branches of learning by teachers who have little chance to gain or to preserve the spirit of inquiry. We can at most hope that the scientific motive may come to these instructors through a study of the psychology which properly underlies their work. It is unreasonable to suppose that they will be able to bring to their work the stimulating influence of those who are a part of the learning they convey. Therefore, if men are to be bred in the ways of the naturalist, the task must be done by investigators. It goes, or should go, without saying that while these men may give and receive profit from their positions as teachers, they should not be called on to do the share of this work which is often inflicted on them, as it is on the teaching body of our schools in general. A condition of this combination of inquiry and instruction is that the two should be associated so as to give the men of science leisure for their studies as well as an opportunity to influence youths by their teachings.

INTERDEPENDENCE BETWEEN RESEARCH AND INSTRUCTION IN GEOLOGY.

There are good reasons why the connection between research and instruction should be preserved in geology, even if it be abandoned in the case of the other sciences. In those other branches of natural learning the subject-matter can be brought into the laboratory, or, at least, as in the case of astronomy, be in some measure made immediately visible to the student, but in geology only a very small part of the facts can be demonstrated by laboratory means. Even where the teacher finds himself in a field which is rich in illustrations, he is sure to lack examples of the greater part of the important facts which he has to bring to the understanding of his pupils. Under these conditions good teaching depends upon the development of the inquiring spirit without the stimulus of a satisfactory direct contact with phenomena. This task cannot be accomplished by any routine methods or by instructors who are not true men of science. It can only be done by those who have the spirit of the investigator in them, who know the range of fact in the intimate and personal way which will enable them to arouse the constructive imaginations of the youth to the task of picturing the unseen—a task which is at the foundation of the best culture which science has to give.

A capital instance of what can be done by a teacher who is also an inquirer is afforded by the work of Louis Agassiz in extending the interest in glacial geology in this country. His lectures on the subject were so vivid, they so effectively presented the physiognomy of the Swiss glaciers, that they quickened the imaginations of the dullest persons. They aroused an interest in the matter which was so intense and on the whole so well informed that the study of glacial geology in the larger sense of the term developed more rapidly and on better lines in this country, where existing ice fields are lacking, than in European lands, where examples abound. In such work we see the part of the master in instruction. As a contrast I may be allowed to relate a story which gives us a notion of what science teaching is likely to become when it is left to the people of routine.

The professor of mineralogy in Harvard University one day observed two young women examining his mineral cabinet, one of whom was evidently searching for some particular species. Offering his help, he found that the object of her quest was feldspar. When shown the mineral she seemed very much interested in the specimens, expressing herself as gratified at having the chance to see and touch them. The professor asked her why she so desired to see the particular mineral. The answer was that for some years she had been obliged to teach in a neighboring high school, among other things, mineralogy and geology, and that the word feldspar occurred so often in the text-book that her curiosity had become aroused as to its appearance.

It will, of course, be possible to give the routine teachers some practical knowledge of feldspar and of the other matters of fact with which they have to deal in their text-book work, but the motive, or the lack of it, which is indicated by the incident will always have to be reckoned on as inseparable from the millwork of ordinary schools. So far as geology is concerned, the instruction of this text-book kind which may be essayed in the secondary schools is quite in vain. Its only effect is to make the youths on whom it is inflicted quite unapproachable by the teacher who may afterwards undertake to introduce them to geology. All of us who have taught in colleges know the youth who has had somebody's 'six weeks of geology' rubbed in by a drudge who, if required to do so, would in a like way have applied Sanscrit. We know that the youth who has been so misused is in most cases, provided he is not blessed with a good capacity for escaping the influences of education, utterly unfit for our uses. The most *economical* thing to do, in the large sense of the word, is to give him the advice which the elder Agassiz was wont to give to those of his students who proved impregnable to his methods of instruction: "Sir, you better go into business."

VALUE OF GEOLOGICAL EDUCATION AND METHODS OF TRANSMISSION.

Comprehensive Character of Geology.

Assuming, as we needs must, that as geologists it is our duty not only to extend the learning of the science, but also to take charge of its diffusion among the people, let us consider in general the value of good which we have to deliver and the manner in which the transmission may best be effected. So far, doubtless for the reason that geologists are uncommonly busy people, there has been little note taken of the importance of the store of the science to society or the way in which the knowledge should be handed down. We have been content to harvest and have hardly considered the work of cultivation; therefore the assessment which I am about to give will doubtless need much revision.

In the first place, we should note well the fact that geology differs from all other divisions of natural learning in that it is not limited to a particular group of facts or modes of energy; but is in a way concerned with nearly all the work which is done in and on this sphere. We should, perhaps, except human affairs; but if he is so minded the geologist may make good his claim to a large share in interpreting that group of phenomena also. In fact, the earth lore is not a discrete science at all, but is that way of looking at the operations of energy in the physical, chemical and organic series which introduces the elements of space and time into the considerations and which furthermore endeavors to trace the combination of the various trends of action in the stages of development of the earth. It is in these peculiarities of geology that we find the basis of its value in education and in the general culture of society, which it is the aim of education to create. It should be in its province, as it is clearly in its power, to give to mankind perspectives which will serve vastly to enlarge the evident field of human action.

All observant teachers know that no true success in education is possible until we contrive an awakening of the youth from the sleepy acceptance of the world about him. To rid the student of this benumbing relic of the bone-cave, the spirit of the commonplace, there is no treatment so effective as that which is in the power of the master in geology to give. The story of the ages clearly told, with a constant reference of the bearing of the matter on the appearance and the fate of man, will quicken any mind that is at all fitted to profit by the higher education. Although geology can hardly be said as yet to have made any such general impression on laymen as is justified by the body of truth which it has to deliver, the close observer may notice certain important changes in the state of the public mind which seem clearly to have been due to the teachings of the science. While many things go into the making of the world's judgments, there can be no question that the plain truths concerning the antiquity of the earth and the series of events which have led to the coming of mankind have in this generation been most effective in overturning sectarian bigotry and in other ways enlarging the spirit of all educated people.

It is evident that the main contribution which geology has to make to those conceptions which may enter into the spirit of our society relates to the position of man; the abstract learning, that which is in and for itself, is for those who have the professional interest. These public values of the science are of two diverse kinds—on the one hand, those which pertain to intellectual enlargement; on the other, to economic development. Therefore in considering our duty by the educational side of our work we should see what the contributions can be to these two modes of endeavor and how they should be presented. First, I shall consider the limitations of that work which may be regarded as distinctly pedagogic.

Divisions of the Science.

It seems to me necessary distinctly to separate the body of the instruction which is to be given in geology into two parts—that which is appropriate to the general public; and that which, though 'caviare to the general,' fits the appetite of the professional-minded. We are indebted to the philosophical pedagogue Herbert for a statement of the self-evident proposition that interest in a matter must exist before information concerning it can be profitably communicated; therefore in our teaching we must take no end of care to provide this foundation for the attention. This care is particularly necessary in the matters of geology, for, as before remarked, the facts cannot often be exhibited in the experimental way, as in the laboratories of chemistry and physics, where the touch of hand or the sight of controlled actions establishes a personal relation with the problems. The teacher of our science has to avail himself of certain antecedent motives which he can presume to exist in any normal youth which may provide the required foundation of interest. What I have to say on this point is the result of nearly a third of a century of experience in teaching geology, and is based on work which has been done with more than 4,000 students. The basis for the induction is sufficiently great to make the conclusions of value. These are in brief as follows: That instruction in geology which is meant for those who have not acquired the professional motive, must find its basis of interest on either of two foundations—on the element of sympathy with all which relates to the fate of man which is native in all of us, or on the love of the open fields, which every youth who is not utterly supercivilized has as a birthright. Each of those interests is in a way primal; both may be separately reckoned on as strong in nearly all youths who are fitted for the higher education.

Class-Room Instruction.

To make use of the motives which may interest the beginner in geology my experience has shown that the first thing to do is to give by means of familiar lectures a general acquaintance with those series of actions which show the long continuous operations of energy in the orderly march of events, taking pains at each convenient opportunity—there are many such— to note how these processes have served to bring about the conditions on which the development of peoples or of states depends. Thus, in treating of volcanoes, the very humanized story of Vesuvius or of Ætna, especially the dramatic episode of the death of Pliny the Elder, is worth much to the teachers for the reason that it serves to bring a sense of human affairs into a subject which for lack of illustration is apt to remain remote and therefore uninteresting. The fact that the story of these volcanoes, especially that of Vesuvius, is inwoven with that of men forms a bond between the mind of the novice and an order of nature which would otherwise be utterly unrelated to him. Again in treating of seashore phenomena, the history of harbors and their relation to the development of states, affords a basis on which to rest the account of coastline work. Yet again, in the matters connected with the formation of mineral deposits, which from the nature of the subject are apt to be somewhat elusive, it is easy to fix the attention by reference to the relation of those stores to the needs of man. So, indeed, in all parts of this preliminary work of awakening and developing interest in his subject, the teacher of geology, if he is to be successful, must go about his task on the supposition that he has to extend existing interests to his field. When men have for some hundred generations appreciated the earth as we would have them do it, the process of selection or the inheritance of acquired characteristics may give a birthright interest in the large problems of geology; but while here and there a youth may be found with a Hugh Miller's taste for the science, the teacher who reckons on having his class thus inspired will fail to achieve success.

Methods of Field Teaching.

As soon as the teacher through his work in the lecture room has succeeded in extending the natural inborn interests of his pupils to the problems of geology, instruction in the field should begin. In this part of the work there is need of a great change in the methods and aims of the teaching. While in the lecture room the conditions require the didactic method and exclude that of investigation, the reverse is the case in the field. When I first essayed peripatetic teaching I made the grave mistake in endeavoring to lecture with the phenomenon as a text. In time I found that the fatigue and other disturbing conditions of the open made students unable to profit by any such didactic method, and that all such direct instruction should be done while they were in the more receptive conditions of the house. The true use of the field is to awaken in the pupils the habit of seeking for themselves. The teacher may trust in this task to the existence of an observant motive in men which is at its best when they are in the open air. All of us, however dull we may be in the housed state, have when afield a discerning humor which prompts us to learn the reasons for the unexplained occurrences of nature. This precious relic of the savage life, of the original motive of curiosity, which has been the source of man's advance on the most of his intellectual upgoings, is in average youths strong; it requires the deadening effects of a long and misspent life to eradicate it in any normal human being. It is to this element of curiosity, informed by the preliminary instruction of the lecture room, that the teacher of field geology should mainly trust for his success.

In practice it will be found impossible completely to exclude didactic teaching in the field—such arbitrary divisions of methods are generally impracticable—but when in face of an exhibition of any geological phenomena, with the briefest possible preliminary, designed to fix the attention of the class upon the facts, the teacher should at once become a mere questioner, a goad to arouse the men to a like interrogation of the things they see. It is important that the first problems of interpretation which are essayed should be of the simplest order, for immediately successful work in the unaccustomed harness is much to be desired. Thus the determination of strikes and dips, the identification of visible faults, and, above all, the careful recording of such facts, should come first and the work be carried to distinct success before any effort is made to use the results in the larger interpretations as to the attitudes of strata. In my experience it is the most desirable in the early part of the field training to give all that can be obtained in the way of work which relates to causes of action, and thus, for the reason that men, however great their training may otherwise be, are unlikely to conceive the earth about them as a realm of continuous processes, their geology is thus not brought down to the present period. The beds and banks of the streams, the retreating escarpments, the shores of lakes and of the ocean—above all the, when rightly discerned, majestic phenomena of the soil—all may serve to impress the pupil with the activity of the earth, and thus clear his mind of the natural but blinding conception that after its creation time the sphere entered on an enduring rest.

Difficulties Encountered in Field Teaching.

In my experience the difficulties which have to be met in field teaching, apart from the hard labor involved in the simultaneous exercise of mind and body, consists in the struggle which the instructor has to make with the incapacities which arise from the supercivilization of his pupils. These hindrances are protean in form, but they are most commonly to be found in an inability to think in three dimensions any better than we can in four, and an incapacity to continue any work when alone. As to the first of these defects there seems to be no resource except to revive the natural dimensional sense which primitive people have. If the student has had sound training in solid geometry he may the more quickly recover the capacity to form the special conceptions which are required of the geologist; but the natural solid is quite another thing from the ideal, and while the theoretical view of them is the same the practical experience is very different. Some youths never learn to deal with the earth problems from the solid point of view. They are therefore cut off from the better uses of the field; yet even with this signal disadvantage they may do good work in certain parts of the science. One of the most distingushed of our American geologists, now dead, was, perhaps on account of the fact that he saw from but one eye, quite without the sense of the relations of the solid; yet, while in the field work his success as measured by his talent was limited, his contributions in other departments were great and of enduring value. Nevertheless, though the people who abide in two dimensional spaces may possess abilities of a high order, they should be kept out of the science which more than any other calls for the ability to frame three dimensional conceptions.

An inability to work alone in the field is a rather common, and in my experience an incurable, defect in certain students who would otherwise be fitted for geology. Those who are thus afflicted appear to lose their motive of inquiry when they are parted from their fellow men. Their malady is to be regarded as one of the many defects of body and mind which are due to over-housing—to that absolute separation from the peace of the wilderness which characterizes our city life.

As soon as possible the field student should be brought to the point where he is required to make his own maps, at first as sketches, and then in the more formal way by pacing, with some methodical control, such as by a simple triangulation. One piece of such map work where the delineation of the surface in general ground plan and contour, as well as the geological coloring, is from his own labor will often be sufficient to affirm the working power of the man. In the ideal of the system such instruction should come to every student who undertakes the study of geology, but in practice it will probably be gained by very few. In the department of Harvard University which is devoted to the science 300 men each year enter on the elementary work. Of these not more than the eighth part continue the study to the point where they may begin to do work which may be regarded as independent; yet fewer essay the training which looks forward to a professional career. As this department has been long established and is favorably conditioned to give instruction, the lack of a large attendance under a system of free election by students may be taken as an indication that while the elementary didactic presentation of the science attracts the greater number of the youths of our colleges, the higher branches are less attractive than the other similarly difficult work of the indoor learning, The conclusion is that geology in the larger sense of the term is, at least in the present condition of culture, an interest for a few chosen spirits who are so fortunate as to be born with a share of the world sense, or at least with an aptitude for studies which demands a measure of the primitive man which is not to be found in the most of our supercivilized folk.

Undesirability of Teaching Geology to Immature Students.

In the demand which is now made for a beginning of all our sciences in the secondary schools it is proposed to include geology in the list and to set boys and girls of from fourteen to seventeen years of age at work upon the elementary work of the learning. For my own part, while it seems to me that some general notions concerning the history of the earth may very well be given to children, and this as information, it is futile to essay any study in this science which is intended to make avail of its larger educative influences with immature youths. The educative value of geology depends upon an ability to deal with the large conceptions of space, time and the series of developments of energy which can only be compassed by mature minds. Immature youths, even if they intend to win the utmost profit from geology, would be better occupied in studying the elementary tangible facts of those sciences such as chemistry, physics or biology, sciences which in their synthesis constitute geology, rather than in a vain endeavor to deal in an immediate way with a learning which in a good measure to be profitable has to be approached with a well developed mind. The very fact that any considerable geological problem is likely to involve in its discussion some knowledge of physics, chemistry, zoölogy and botany is sufficient reason for postponing the study until the pupil is nearly adult.

EXPERT WORK AND ITS INFLUENCE AND REQUIREMENTS.

Besides the relations to society which may be established by his position as a teacher, the geologist is from the character of his studies much called on for another kind of help, that which pertains to the development of earth resources or to the litigation which concerns earth values. In this field the relations are more critical and more perplexing than in that of instruction. The results of blundering are more apparent and their immediate effect on the reputation of the science more unhappy. That this branch of learning has managed to retain a fair place in the esteem of the public in face of the criminal blunders which its prophets have made is indeed remarkable. It shows how much our people are disposed to pardon where they believe that men mean well, however ill they may do. There is, however, a lesson from this unhappy experience which we should all read and inwardly digest. This is in effect that what is called expert work demands other qualities of mind and another training than those which go to make a successful investigator or teacher. We, as well as the general public, need to recognize that fact, that there is as much reason to suppose that a noted teacher of political economy should prove successful in determining the merits of a proposed business project as that his colleague in geology should be fit to advise in regard to a mining venture. The teacher may be an expert in the economics of the profession, but the proof of the fact is not to be found in his scientific work or in his success as an instructor. If he has not had the other training it may be safely assumed that he will be totally unfitted to wrestle with the tricky fellows who try in amazingly varied ways to deceive him, or even with the tendencies of his own mind, which naturally lead him to see riches where others fancy they discern them.

In the interests of our science it is most desirable that all expert work should pass into the hands of a body of men who should bring to their task so much of geology as is needed for the particular inquiry, commonly not very much, and who can join with it the more important practical acquaintance with the miner's art and the conditions of trade which relate thereto. In certain cases the men of theory may well serve these experts; all their inquiries are likely to be of service in the determinations, but on them should not be the responsibility for the business side of the problems. There is little the geologist does in the way of research which may not have some practical application to the affairs of men, but he should not mistake this possibility of usefulness as an indication that it is for him to give his inquiries an economic turn.

CONCLUSION.

We thus see that geological science, like the most of the other branches of natural learning, has two distinct points of contact with society—that of instruction and that of economic affairs. In each of these fields of usefulness its services to man have been great and are to be far greater in the time to come. As for instruction, the task is to give to men an adequate perspective for their lives. It is to ennoble our existence by showing how it rests upon the order of the ages. In the economic field it is to show the resources which these ages have accumulated in the earth for the service of the enlarged man, who is to attain his possibilities by a full understanding of his place in nature. To do the fit work we need to combine the functions of explorers and guides zealous to open the way to the unknown, and those of teachers who take care that the youth of our time are led into the land which we know to have so much promise for man.

SOME VALUES OF STELLAR PARALLAX BY THE METHOD OF MERIDIAN TRANSITS.

IN this article are presented values of the parallax for thirteen of the list of nearly ninety stars upon which I have been engaged at this observatory the past two years. The results here given include the values presented at the Springfield meeting of the American Association for the Advancement of Science, with some additions. They are the results of preliminary solutions based upon all my observations of these stars available at the time, and equal weight has been given to each observation.

The method employed is that of the differences of meridian transits, and it is believed this is its first application since it was introduced in its present detail by Prof. Dr. J. C. Kapteyn at the Leiden Observatory in 1885–87. He determined the parallaxes of fifteen stars by this method with a high degree of accuracy. The observing consists in noting the successive times of transit of three stars, of which the first and third are comparison stars and the middle star is the one whose parallax is sought. The former should be so chosen as to make the group of three stars as symmetrical as possible in both position and magnitude. Of course, a fine meridian instrument is required, and for the present series the REPSOLD meridian circle of 12.2 c.m. was employed with a power of 180 diameters. To give the instrument greater freedom the clamp arm was detached from the pier, excepting for a few of the earlier observations. Screens of fine brass wire were used to reduce the apparent magnitude of the brighter stars so as to make them more comparable with the fainter stars. The screens were mounted on a frame travelling north and south and entirely separate from the instrument. They were used not for fear of the errors arising from momentary uncertainty on the part of the observer, but for fear of a systematic change in his habit of noting the bisections of the brighter stars. Such a change might come about gradually during the six months' interval between two successive epochs of observation and would enter directly into the concluded parallax. To prepare each observation of a group of three stars for combination with other observations of the same stars a simple reduction is made. The differences of the observed times are corrected for deviation of the instrument from the meridian and for proper motion of the stars so far as they are known, and then reduced to a common equinox. The effect of the clock rate in well selected groups of stars is rarely appreciable. The solution is then made so as to determine three unknown quantities, namely, the normal difference in time between the middle star and the point exactly midway between the first and third stars, the residual correction for proper motion and the parallax.

The method has certain distinctive advantages and disadvantages to be foreseen which may here be noted. The former are as follows: 1. The absence of any known systematic effect of refraction, thus avoiding any refraction term whatever in the reductions. 2. The simplicity of the observations and reductions and the rapidity with which the former may be secured. 3. The great freedom allowed in the choice of comparison stars as regards distance from the principal star in zenith distance. 4. The stability of the instrument and the fact that it is untouched at the moments of actual observation. 5. The ease with which the condition may be secured that all observations on a given star shall be made with the same position of the instrument and of the observer. As compared with one or another of the modern, refined methods of measuring stellar parallax, the following advantages may also be given: 6. A large dimension of the parallactic orbit is always measured. 7. All observations are made at the same place in the field of the eyepiece. 8. The attention of the observer is directed to one point only at a time.

The disadvantages are as follows: 1. Limitation to meridian passages, so that observations at the time of maximum effect of parallax are in general impracticable through one-half of the year. 2. Limitation in the choice of comparison stars, since brighter stars must be selected on account of the smaller apertures of meridian instruments. This necessitates moreover greater intervals between the stars allowing more time for disturbances to occur affecting the transits of the stars. 3. The necessity of moving the entire telescope in passing from one star to the next, sometimes requiring a change of several degrees in the pointing of the instrument and incurring the risk of inducing strains among its parts. 4. The fact that the instants of observation of any two stars cannot be made simultaneous.

The present observations were made on an illuminated field. In making up the star groups I gave the preference to symmetry of position over that of magnitude. The observing list has seemed too crowded in some places, but the influence of this and of any other adverse circumstances will be better determined by the final discussion. In order to secure, if possible, a fair number of observations at each epoch, I have continued the observing in general on poor as well as on good nights. Numerous observations have been made on miscellaneous stars, with and without the screens, to determine at any time the personal equation depending upon the apparent brightness of a star; but these have not yet been reduced.

The values of the parallaxes resulting from the present solutions are given in Table I. The average number of observations entering into each value is 35. All the stars have been solved in the regular manner except the last two, which presented a peculiar case to be explained in the following. Of these *85 Pegasi* was reduced with its second comparison star only with an inappreciable parallax as the result.

In Table II. are presented all the previous determinations of parallax that I have found for the stars of Table I., excluding some older and much more uncertain values. The several columns are sufficiently explained by the headings except the third, and here the letters given denote different methods of observing, as follows:

H. By the heliometer.

M_1. By the filar micrometer attached to the equatorial telescope and from measures of distance and position angle combined; M_2, from distance alone; M_3, from position angle alone; M_4, from differences of declination.

Z. By measures of the zenith distances of the parallax star alone, in the meridian.

R. By observations of right ascension in the ordinary manner.

P. By measurement of photographs.

T. By differences of meridian transits employing special comparison stars.

In the case of *α Lyræ* the letter *c*, in the fifth column, indicates that the measures were made from the companion star. The value given for this star from *Peters* is the only *absolute* parallax in the table. For *μ Cassiopeiæ* and *α Lyræ* I have included my own results, assigned the several independent values different weights, somewhat arbitrarily, and combined them all into one mean value given in the table.

TABLE I.

NAME OF STAR.	Mag.	R. A.	Dec.	Prop. Mot.	Parallax.
		h	°	″	″
μ Cassiopeiæ	5.2	1.0	+54	3.8	+0.12
Lalande 15290	8.2	7.8	30	2.0	+ .10
Lalande 15565	7.5	7.9	29	1.2	+ .03
Lalande 18115, *pr*	8.0	9.1	53	1.7	+ .15
δ Ursæ Majoris	3.2	9.4	+52	1 1	+ .13
20 Crateris	6.2	11.5	—32	1 1	+ .15
γ Serpentis	4.0	15.8	+16	1.3	+ .13
η Herculis	3.7	16.6	39	0.1	+ 20
Lalande 30694	7.0	16.8	0	1.6	+ .02
70 Ophiuchi	4.2	18.0	2	1.1	+ .17
α Lyræ (Vega)	0.2	18.6	38	0.4	+ .05
Lalande 47019	8.1	23.9	26	..	+ .24
85 Pegasi	5.8	23.9	+26	1.3	+0.02

TABLE II.

NAME OF STAR.	Authority.	Method.	Parallax.	No. of Comp. Stars.	Probable Error	Weight.
μ Cassiopeiæ	O. Struve	M_1	+0.″342	1	±0.052	6
	Schweizer	M_3	+ .084	1	.060	5
	Pritchard	*P*	+ .035	2	.018	10
	Flint	*T*	+ .120	2	.044	8
	Weighted Mean.		+0.130		±0.020	
δ Ursæ Majoris	Kapteyn	*T*	+0.052	2	±0.026	
η Herculis	Belopolski (Wagner)	*R*	+0.40	..	0.072	
70 Ophiuchi	Krueger	*H*	+0.150	2	0.006	
α Lyræ	W. Struve	M_2	+0.262	*c*	±0.025	4
	C.A.F. Peters	*Z*	+0.116	..	.050	4
	O. Struve	M_1	+0.147	*c*	.010	8
	Johnson	*H*	+0.141	2	.047	2
	Brünnow	M_1	+0.212	*c*	.011	6
	Brünnow	M_4	+0.188	1	.033	2
	Hall	M_4	+0.134	*c*	.006	10
	Elkin	*H*	+0.092	6	.019	10
	Flint	*T*	+0.049	2	.037	6
	Weighted Mean.		+0.138		±0.008	
85 Pegasi	Brünnow	M_1	+0.054	1	±0.019	

As regards the apparent uncertainty of results, the present method cannot take rank with the best work done with the heliometer and the filar micrometer, or perhaps with that done by the aid of photography. As shown by Dr. KAPTEYN's refined determinations, however, this method seems singularly free from systematic error, and its trustworthiness may be higher than that assigned by its accidental error alone. In the present series a material reduction of the apparent uncertainty of any single night's observation of a given star would result from diminishing the weights of the poorer nights. The average probable error of the parallaxes of Table I. is $\pm 0.''046$, and, therefore, the true values should be within one-tenth of a second of the numbers there given. When we consider average values of parallax, however, we have a more trustworthy determination of the distance of certain stars as a class. Thus ten stars of the list have a proper motion of one second or more. The mean value of their parallaxes is $+0.''11$, with a probable error of $\pm 0.''015$, so that the average distance of these stars is indicated to be such as to require about thirty years to be traversed by light. Table I. contains one star, *Lalande 47019*, which found entrance quite unexpectedly. It was the first comparison star for *85 Pegasi*, and the latter was first reduced in the regular manner but showed a negative parallax. This was explained upon making comparisons of the first star, *Lalande 47019*, with *85 Pegasi* and the third star of the group separately, for the two solutions resulted in positive and nearly equal values of the parallax for the first. The mean of these two values, $+0.''21$ and $+0.''27$, is given in the table. An inspection of the data indicates that this is a real parallax, and not merely an apparent one such as might be ascribed to personal change. The magnitudes of the stars were 8.1, 6.1, 6.2 respectively, and no screens were employed in this group. I included in the examination a number of observations made with the screens expressly as a control on the personal equation depending upon the brightness of the stars. The case of *Lalande 47019* is an interesting one, since the star is faint and the comparison of four catalogue positions extending from 1800 to 1890 gives no plain indication of proper motion. Yet the results indicate that it is the nearest star of the thirteen in the table. With this separate presentation of *Lalande 47019* and *85 Pegasi*, it will be noticed that while some of the parallaxes are very small yet they are all positive. According to the law of chances some of these values should be the lowest possible ones derivable for the individual stars and some should be the highest possible values. The fact that they are all positive and comprised within so limited a range indicates that the observations are not liable to such systematic errors as have even led sometimes to large negative values of parallax, and strengthens the hypothesis that the stars of large proper motion are on the whole comparatively near us.

In the case of two of the stars we have several independent determinations as shown in Table II. For *η Cassiopeiæ*, one of the stars having a remarkably large proper motion, the results indicate a definite parallax of about $0.''13$. The number of separate determinations, however, is few, and we can only say that the chances are that the distance of this star is such that it requires somewhere from 22 to 30 years for its light to reach us. *α Lyræ* has been a favorite object for parallax observations, owing to its brilliancy and its favorable position for northern observatories, and consequently we have a good determination of its distance. The concluded value of the parallax, $+0.''138$, corresponds to a light journey of 23.6 years, and the uncertainty of this result is so small that the chances are that the time actually required is somewhere between 22.3 and 25.1 years, while we may feel confident it cannot be more than 33 years nor less than 18 years, that its light requires to reach our system.

A. S. FLINT.
WASHBURN OBSERVATORY, MADISON, WIS.

OZARKIAN EPOCH—A SUGGESTION.

AMONG the voluminous writings on various geological subjects published during the past ten years, there has been frequent mention made of an erosion interval occurring between the Lafayette formation and the lowermost glacial deposits. Those who have studied the subject in the coastal plain or southeastern portion of the United States agree in asserting that this erosion period, was the longest and in every way the best marked of any that have prevailed over any portion of the continent since the close of the Tertiary Era. In that broad belt of unglaciated highland which occupies the interval between the inner edge of the coastal plain and the outer border of the drift-covered district, this post-Lafayette erosion period is as easily distinguished as on the lower country near the coast. Indeed, if the evidence of its length were derived solely from the amount of rock excavation accomplished, this inner district could be relied on chiefly to furnish this evidence. In both districts the period of erosion was begun by an elevation of the continent above its normal altitude, thus enabling the meteoric waters to institute a vigorously erosive system of drainage. It was terminated by a general subsidence of the eastern portion of the United States, and in consequence an extensive submergence in the coastal plain region and the Mississippi basin.

But in the drift-covered district, where evidence of this post-Lafayette elevation and erosion are not wanting, but frequently obscured by other phenomena, the upper limit of the erosion interval was the Kansan epoch of glaciation. This epoch was followed by another of erosion on the previously ice-covered region, which was itself many times longer than any which have succeeded it. These two important sub-divisions of the Glacial period are the chronologic equivalents of the latter portion of the post-Lafayette period of erosion as developed outside the limits of the glaciated district. Severing this latter portion there still remains a long period of sub-aërial erosion, the equivalent of what in the North has been denominated the pre-Glacial epoch of erosion. Recent studies have indicated that this early pre-Kansan erosion epoch constituted at least one-half of the post-Lafayette period of erosion. In fact, it occupied a very large part of the time which has elapsed since the close of the Tertiary era.

There is, I believe, general agreement among geological students that the post-Lafayette period of erosion is early Quaternary in age. I shall not argue this subject, but assume that it has been demonstrated by various writers that the period immediately supervened upon the close of the Tertiary era. Consequently, being Quaternary in age, the portion of it which intervenes between the institution of the era and the opening of the Kansan epoch constitutes the first and not least important epoch of the Pleistocene period (which, as I understand the consensus of opinion, is considered to date from the beginning of the era).

Now, up to the present time, so far as I am aware, there has been no specific term applied to this first epoch as here defined, except the rather indefinite one, pre-Glacial. As it presented features both in conditions of erosion, climate and flora, somewhat similar to those which characterized subsequent inter-Glacial epochs, and in marked contrast to those which characterized the Glacial epochs, all of which have been already named, it is evident that it deserves some specific application which will facilitate future studies into the natural subdivisions of the era. The name wanted might be secured in the coastal plain, but there it is difficult, if not impossible, to separate this from the subsequent epochs to which, as before stated, the latter portion of the pre-Columbian erosion interval belongs. Instead, we may more properly derive the desired term from some geographical designation of some portion of the unglaciated highland just without the glacial boundary. I hereby suggest that it be hereafter known as the *Ozarkian epoch.* True, while the post-Lafayette period of erosion is as well represented by phenomena occurring in the Ozark Plateau region, the particular portion of it included in this epoch is no better demarked than in the coastal plain. But the Ozark region immediately adjoins a drift-covered region on which the Kansan drift sheet is widely exposed, and when the two regions have been exhaustively studied the relation of the drift to the valleys along the border will furnish data for discriminating the proposed Ozarkian epoch from that which followed. The geographical element of the term has been already used in geological nomenclature, as, for example, the Ozark Series, the Ozark Uplift and the Ozark Plateau, but the term as suggested differs so widely from those in use that it can never be confounded with them. Furthermore, the term is euphonious and in harmony with the nomenclature already adopted for the other epochs of the Pleistocene period.

The Ozarkian epoch as here proposed may be defined as a marked period of elevation and sub-aërial erosion instituted by the great post-Tertiary epeirogenic uplift of North America, and terminated by the Kansan epoch of widely extended glaciation. The following general table of the sub-divisions of the Quaternary Era graphically exemplifies its relative position:

	RECENT P.	PRESENT EPOCH		DEPOSITION.
		TERRACE EPOCH		EROSION.
QUATERNARY ERA.	PLEISTOCENE PERIOD.	Wisconsin Epoch	3d Glacial	Drift.
		Toronto ? Epoch	2d inter-Glacial	Erosion.
		Iowan Epoch	2d Glacial	Drift.
		Aftonian Epoch	1st inter-Glacial	Erosion.
		Kansan Epoch	1st Glacial	Drift.
		Ozarkian Epoch	pre-Glacial	Erosion.

Lafayette Period.....Deposition.

Oscar H. Hershey.

Freeport, Ill.

[Note. The subdivisions of the Pleistocene period in the above table, except the last, are from Chamberlin's classification of the drift. The inter-glacial epoch between the Iowan and Wisconsin stages of glaciation has been provisionally named from the fossiliferous beds at Toronto, Canada, although it is considered far from certain that these strata belong to this epoch.

It is not customary to affix names to periods of erosion, although these are generally the longest and often the best marked divisions of geologic time. It has been suggested that it would be well to simply recognize the intervals of erosion, when encountered in any region, and wait until deposits occupying them have been discovered, before naming them. But in the case of the particular one under discussion, the conditions were such that no deposits contemporaneous with it are likely to be discovered. During the period of elevation which immediately succeeded on the Lafayette submergence the shore line was far beyond its present position, and the river alluvium and marine deposits of that epoch are buried under later formations and covered by the sea, where they can never be examined. Nor are there any correlative glacial deposits which could furnish a name to the epoch. The Ozarkian epoch as proposed is to terminate previous to the earliest Pleistocene glaciation of any portion of North America, except, perhaps, the far North. At present the Kansan epoch, which is to include the advance and retreat of the ice sheet which formed the so-called Kansan drift, is considered the first of the great glaciations. But if any decisive evidence of any previous distinct glaciation should be discovered it would constitute a new epoch and simply detract from the length of the Ozarkian epoch. The writer is of the opinion that the portion of the Quaternary era characterized by glacial conditions began at some time subsequent to the opening of the era, and it is to this distinctively pre-glacial portion that I wish to attach the name, Ozarkian epoch O. H. H.].

ORGANIC MARKINGS IN LAKE SUPERIOR IRON ORES.

At the instance of Dr. Charles D. Walcott, Director U. S. Geological Survey, and with the kind permission of the editor of this paper, I beg to submit the following note, hoping that the subject may be brought to the notice of the officers of the U. S. Geological Survey, the Geological Surveys of Michigan and Wisconsin, etc., as well as that of all field workers among the rocks of the iron-ore regions whose structural and paleontological geology in detail has yet to be unraveled, or is at present being worked up for publication, in this as well as in other countries.

I merely desire here and now to announce the discovery of traces of organic remains, made by me in fragments of iron ore from the Chapin mine, Iron Mountain, Menominee, Michigan, as well as possibly from other mines on the same range or elsewhere in the Lake Superior region. It is hoped shortly to publish a much fuller account of my work in this connection, in another place.

During the period of 1890–93, I collected a considerable number of specimens of iron ore from the ore piles on the docks at Erie, Pa., and was firmly of opinion that some of the markings upon them or in them were of organic origin, produced by animals of some kind; but being only an amateur geologist, I decided to submit the material to Prof. H. S. Williams, of New Haven, Conn., for examination. After seeing the specimens, Prof. Williams kindly wrote: "There are certainly some among them which resemble very strongly the trailings left by worms or crawling things on the sand."

The material was then forwarded to the U. S. National Museum, Washington, D. C., where Prof. Charles Schuchert, assistant curator of the Museum—Smithsonion Institution—examined them, and said: "The specimens of the Algonquin ores contain annelid trails."

Finally they were placed in the hands of Dr. Chas. D. Walcott for examination and he kindly reported as follows: "Most of the specimens from the Lake Superior region containing 'traces of organisms in Lake Superior iron ores' show only markings of mechanical origin. A few, numbers 10, 14, A, E and G, appear to be casts of the trails of a small annelid and are, I think, organic. It is not possible to identify them with any described species. For convenience of reference they can be referred to the genus *Planolites*."

Prof. C. R. Van Hise, geologist in charge U. S. Geological Survey, Lake Superior Div., also saw the specimens and remarks that in his opinion the markings might possibly have been produced by some complex movement or movements, but that they are very peculiar, and in any ordinary case would be unhesitatingly accepted as organic. My long-since-formed opinion as to the organic origin of these markings having thus been confirmed by the highest authorities, this discovery will doubtless add a new phase to the question or controversy regarding the origin and age of these ake-region iron ores, and iron-bearing series of strata, and also should tend to excite renewed and closer investigation of the Huronian rocks in search of better 'fossils' than mine, which surely exist and will eventually be brought to light.

Those especially interested could, no doubt, see these specimens on application to Prof. Schuchert, at Washington, in whose care I propose to let them remain for the present.

W. S. GRESLEY.

ERIE, PA.

FOOD OF THE BARN OWL (STRIX PRATINCOLA).

IT is well known that birds of prey disgorge the indigestible portions of food, such as hair, bones and feathers. These are formed into balls, known as 'pellets' or 'rejects,' by the muscular action of the stomach and are regurgitated before a new supply of food is taken. The 'pellets' contain the skulls, teeth, and other parts of the victims, and furnish a perfect index to the food eaten. In a work on 'The Hawks and Owls of the United States,' published in 1893, I recorded the results of the examination of 200 'pellets' or 'rejects' of the Barn

Owl taken from one of the towers of the Smithsonian Institution, Washington, D. C., June 28, 1890. Since that time 475 more have been collected—125, September 14, 1892; and 350, January 8, 1896, making in all a total of 675 'pellets.' This abundant material has been carefully examined and found to contain the remains of 1821 mammals, birds and batrachians as shown in the following table:

1119	Meadow Voles (*Microtus pennsylvanicus*)
4	Pine Voles (*Microtus pinetorum*)
452	House Mice (*Mus musculus*)
134	Common Rats (*Mus decumanus*)
1	White-footed Mouse (*Peromyscus leucopus*)
20	Jumping Mice (*Zapus hudsonicus*)
1	Rabbit (*Lepus sylvaticus*)
33	Short-tailed Shrews (*Blarina brevicauda*)
21	Small Short-tailed Shrews (*Blarina parva*)
1	Star-nosed Mole (*Condylura cristata*)
1	Brown Bat (*Vesperugo fuscus*)
2	Sora Rails (*Porzana carolina*)
4	Bobolinks (*Dolichonyx oryzivorus*)
3	Red-winged Blackbirds (*Agelaius phœniceus*)
1	Vesper Sparrow (*Poocœtes gramineus*)
10	Song Sparrows (*Melospiza fasciata*)
4	Swamp Sparrows (*Melospiza georgiana*)
1	Swallow (*Petrochelidon*)?
1	Warbler (*Dendroica*)
6	Marsh Wrens (*Cistothorus palustris*)
2	Spring Frogs (*Rana pipiens*)?

A glance at this list will demonstrate to any thoughtful person the immense value of this useful bird in keeping noxious rodents in check. Moreover, judging from the species in the list, it may be seen that the barn owl hunts almost exclusively in open country, such as cultivated fields, meadows and marsh lands, where such pests do most damage. In Germany, according to Dr. Bernard Altum (Journal f. Ornithologie, 1863, pp. 43 and 217) the barn owl feeds extensively on shrews. In 703 'pellets,' a number only slightly greater than that which I examined, he found remains of 1,579 shrews, an average of over two to each 'pellet,' while our 675 'pellets' contained only 54 shrews, an average of one skull to every $12\frac{1}{2}$ pellets. On the other hand our material contained the remains of $2\frac{1}{2}$ mice to each 'pellet,' or 93 per cent. of the whole mass. The birds, which constitute about $4\frac{3}{4}$ per cent. of the owl's food, are in the main species of little economic importance.

A. K. FISHER.

CURRENT NOTES ON ANTHROPOLOGY.

THE ETHNOLOGY OF TIBET.

A VALUABLE article on this subject is published in the last report of the National Museum (Washington, 1895), prepared by the experienced traveler, Mr. W. W. Rockhill. It describes the social customs, dress, habitations, agriculture, food, music, money, religion, etc., of the Tibetans with much minuteness.

Their civilization was demonstrably obtained either from India or China, those who may be styled the indigenous inhabitants contributing very little to it. These indigenes are now best represented by the scanty and semi-nomadic population of the northern plateaux, which rise to an average altitude of more than 15,000 feet above the sea level. They are known as 'Drupa,' and although they belong to the same linguistic family as the Burmese they are more remote than these from the physical type of the Mongols. The hair, instead of being straight, is wavy, the eyes brown or hazel, the nose often narrow and not much depressed at the root. The skin is frequently nearly white and the cheeks rosy, though on exposure the complexion may become a dark brown.

These traits present a physical type quite dissimilar from that which ethnographers term the Mongolian.

RESEARCHES IN AMERICAN ARCHÆOLOGY.

THE twenty-ninth report of the Peabody Museum of Archæology and Ethnology, at Cambridge, Mass., is brief, covering but nine pages, but contains a number of interesting references to the researches in which the institution is engaged.

The most noteworthy relates to the exploration of the ancient city of Copan, Honduras. A wonderful stairway has been discovered, twenty-four feet in width, and leading to the summit of a pyramid over one hundred feet in height. It is built of massive blocks of stone, the front of each of the steps being covered with deeply-cut hieroglyphs and delineations of the human form. When once restored and copied, we may indeed find on it, as the report says, "the most important hieroglyphic inscription in Central America."

A curious addition to the Museum is the only ancient New England bow in existence. It is five feet seven inches in length, being much longer than has generally been stated. The Hemenway collection from the Salt River valley has been deposited in the Museum by the executors and arranged by Dr. J. Walter Fewkes. About twelve students are studying in the department under the direction of Professor F. W. Putnam and his assistant, Dr. Dorsey.

THE ALLEGED TERTIARY MAN OF BURMAH.

Considerable attention was attracted early last year by the assertion of Dr. Noetling, repeated in various periodicals, that he had discovered in a miocene layer, on the banks of the Irrawadi river, rude flint implements of 'palæolithic' patterns. Later in the year he announced that the strata were not miocene, but certainly pliocene, and therefore tertiary man was still saved.

Another geologist, Mr. Oldham, in *Natural Science*, September, 1895, questioned the occurrence of the flints in the original deposit. It appears that the face of the outcrop has a veneer of mud washed down from the super-incumbent strata, adherent to its ferruginous surface, and that the chipped flints are found in this coating. Just such 'implements' are scattered over the plateau above, and would naturally be washed down with the surface soil in heavy rains.

This demonstration seems to relegate the Burmese find to that region of extreme doubtfulness in which at present every alleged discovery of tertiary man in Europe or America rests.

RACIAL DEGENERACY IN AMERICA.

A well prepared article on this subject is contributed to the *University Medical Magazine*, January, 1896, by Dr. Albert S. Ashmead. He reviews the prevalence of goitre, cretinism, leprosy and dwarf stature in America as factors in ethnic physical and psychical degeneration. In his survey he includes the native as well as the immigrant American and African races, and collects a large amount of references on the subject. On the whole, it cannot be said that he has shown any special tendency of humanity in the New World to retrogressive transformation or racial pathology. The causes to which he alludes are frequent in the other continents with like effects.

What would be especially desirable in this direction would be a study of the white race in the United States in isolated localities where its members have been subjected to the environment for a hundred years or more with little access of crossings from without. Undoubtedly, important modifications have taken place, but they have not yet been critically collected.

PSYCHOLOGICAL NOTES.

THE SENSE OF EQUILIBRIUM.

Interesting experiments are reported in the *Biologisches Centralblatt* by Bethe on the connection between the sense of equilibrium and the semi-circular canals. He finds that doves are not well adapted to exhibiting this connection; he allows dead doves with their wings distended by wires, to fall through the air, and finds that the structure of the body is such that equilibrium is preserved, and is even recovered if the body is started half way over. Hence these birds, if active, can still often fly reasonably well after the semi-circular canals have been extirpated. But the case is very different with fishes, and they, consequently, exhibit the usual effects of mutilation very perfectly; after total extirpation of the labyrinth on both sides, they swim with complete oblivion of the attitude proper to the fish in water. The author also believes that some fishes at least learn to guide themselves by their labyrinth sense only after some experience. The subject is one of great interest, and this paper is a distinct contribution to our knowledge regarding it.

C. L. F.

THE PHYSIOLOGICAL CONCOMITANTS OF SENSATIONS AND EMOTIONS.

THE first issue of the *Journal of Experimental Medicine* contains an experimental research from the Physiological Laboratory of John Hopkins University by Dr. T. E. Shields on the effects of odors, irritant vapors and mental work upon the blood flow. The author regards his chief results to be improvements in Mosso's plethysmograph. With this instrument changes in the volume of the arm are measured and it is assumed that the blood withdrawn from the arm is called to the brain as a result of mental activity. The apparatus is complicated and Dr. Shields has used great care in eliminating various sources of error. He finds that odors and mental work cause (presumably) congestion of the brain. Even when the volume of the arm is at first increased, this is due to the acceleration of the heart rate, which would also tend to increase the supply of blood to the brain. Dr. Shields' experiments contradict Lehman's view that pleasant sensations decrease the blood supply to the brain. The article is admirably illustrated.

DR. F. KIESOW, in a paper (*Philos. Studien*, XI., 1) not referred to by Dr. Shields, has used Mosso's new sphygmomanometer for similar purposes. With this instrument the pressure of the blood in two fingers is measured. Strained attention, mental operations, such as multiplying, sudden noises, sudden pains, etc., were used. The results were varied and difficult to interpret. Sometimes there was no alteration in pressure, sometimes there was a decrease, but more commonly an increase. Dr. Kiesow concludes that the alterations are not due to the sensations nor to the attention as such, but to the feelings that accompany them.

IN an extended investigation (*Philos. Studien* XI., 1, 3 and 4) Dr. Paul Mentz has studied the effects of sounds on the pulse and on breathing. A single noise or tone of moderate intensity caused a slower pulse and usually a slower rate of breathing, which the author attributes chiefly to the pleasure accompanying the sensation. If the sounds are intense or long continued the pulse becomes quickened. When music was listened to passively the rate of the pulse was decreased, but it was quickened when the attention was strained.

J. McK. C.

SCIENTIFIC NOTES AND NEWS.

THE ACTION OF THE HOUSE OF REPRESENTATIVES ON THE METRIC BILL.*

THE Hon. C. W. Stone, Chairman of the Committee on Coinage, Weights and Measures, received notice on Tuesday afternoon, April 7th, that he would be given an opportunity to call up at once the Committee's Bill in regard to fixing the standard of weights and measures, according to the Metric System of weights and measures. The hour was late, but Mr. Stone promptly made his argument in favor of the Bill, Mr. Stone's speech was a thorough and

* Based upon the report of the correspondent of the New York Dry Goods Economist.

comprehensive discussion of the proposed change, preceded by a historical sketch of the origin of the system, He quoted the prediction made by the Hon. John A. Kasson in reporting the bill in 1866 to the House, that a subsequent House would make, at a not-distant date, exclusive and compulsory the measures then simply legalized. He cited the strong indorsements which the system has received from the late Secretary Blaine, Postmaster-General Wilson, Secretary Caslisle, The Director of the Mint, the Superintendent of the Coast and Geodetic Survey, etc., and dwelt at some length on the letter of the Hon. J. S. Morton, Secretary of Agriculture. He discussed also the magnitude of our commercial relations with Metric-using countries and showed the ease with which the system had been adopted by different peoples. He cited the British Consular reports, showing Great Britain's loss through retaining her old and awkward systems, and explained the present progress toward the Metric System by the three remaining non-Metric countries, the United States, Great Britain and Russia.

Mr. Stone's speech was very well received, and it was first thought that a vote would be taken without debate. Mr. Bartlett, of New York, however, secured the floor and made a short speech in opposition to the bill. He was followed by Representative Otey, of Virginia, who made a humorous speech against the Metric System, dwelling chiefly upon the Metric terms. Mr. Hurley, of Brooklyn, replied in a dignified manner to Mr. Otey's effort and suggested that in the hands of a humorist our present system could be made very ridiculous. After more discussion Mr. Stone called for a vote, and on a division of the House there were 65 votes in the affirmative and 80 in the negative. The vote being less than a quornm, Mr. Stone succeeded in securing an adjournment, and the fight went over until Wednesday morning, when the yeas and nays were ordered. After the experience of the day before, Mr. Stone was anxious to gain time, believing that it was only necessary to acquaint the members further in regard to the system under more favorable conditions than those of a noisy debate in the House, to secure the passage of the bill; but a vote could not be avoided, and when the announcement was made that the bill had passed by a vote of 119 to 117 a shout of applause went up from the floor and galleries. Those who had opposed the bill, however, took courage, because of the narrow majority in favor of the bill, and promptly moved a reconsideration. Upon this motion yeas and nays were ordered and the opponents of the bill went vigorously to work to change votes, with the bugaboo of the angry farmer protesting against being tangled up with a new system of weights and measures on the eve of a Congressional election. The result of this work was soon apparent. Mr. Hurley's motion to lay the motion to reconsider on the table was lost by a vote of 136 to 111, and the motion to reconsider prevailed by a vote of 141 to 99. Mr. Stone's only remaining chance was to ask to have the bill recommitted to his Committee. This motion was carried *viva voce*.

After the battle in the House many members who had voted against the bill expressed themselves as not being opposed to it for any reason except that they did not understand it; while others did not hesitate to say that it would be a very easy thing to put through after election. A Western member voiced the sentiment of many of his colleagues in a paraphrase of one of Mr. Otey's witticisms, saying: "If I should talk to my farmers about kilograms they would kill me next November."

The campaign for the introduction of the only enlightened system of weights and measures known to the world will go on unchecked, and sooner or later the United States will follow the other nations of the earth in its adoption.

THE NEW EDINBURGH OBSERVATORY.

THE new Royal Observatory at Edinburgh was opened on April 7th by an inaugural ceremony in which Lord Balfour, Lord Crawford and Sir Robert S. Ball took part. Edinburgh has long had a fairly well equipped observatory, but several years ago the Earl of Crawford presented his fine collection of instruments to the observatory, and as there was not room to use these properly a government grant amounting to £36,000 was secured for a new building. The building and its equipment are said to be much superior to any other in Great Britain, though they do not compare favorably with the great American observatories. According to the description in the London *Times*, the buildings consist of the observatory proper, the official residence of the Astronomer Royal, the residence of the assistant astronomers and subsidiary buildings. The Observatory is a T-shaped building, the head of the T facing the north with a frontage of 180 feet, and having at each end a telescope tower, of which the eastern is 75 feet high and 40 feet in diameter, and the western is 44 feet by 27 feet. The former contains the most important instrument in the observatory—a new refracting telescope of 15-inch aperture. The latter contains the reflecting telescope, removed from the Calton observatory, which has an aperture of 2 feet, and which is to be used in astro-physical researches. From the western tower a sloping gangway leads upwards to the transit house, in which is a telescope of 8½ inch diameter resting on a horizontal axis. Connected with the Observatory, there are a well-equipped photographic laboratory, and a library with accommodation for some 30,000 volumes, which is already well furnished with the Dun Echt collection.

The director of the Observatory is Mr. Ralph Copeland, Astronomer Royal for Scotland and Professor of Astronomy in the University of Edinburgh.

OCCURRENCE OF THE NATIVE WOOD RAT AT WASHINGTON, D. C.

THE Alleghany Wood Rat, *Neotoma pennsylvanica*, inhabits the Alleghany plateau from the mountains of North Carolina to southern New York. In Virginia it is known to occur at several localities in the Blue Ridge Mountains. Recently, in trapping among the rocky cliffs along the west side of the Potomac River, four miles above Washington and a quarter of a mile from the old boundary line of the District of Columbia, I secured five of these rats. They are fairly common at this point, which they doubtless reach by following the river cliffs from Harper's Ferry, where the Potomac cuts through the Blue Ridge. No doubt they come a little farther down, probably to the end of the high ridge opposite Georgetown.

The rats were caught under masses of broken rock and in clefts and caverns in the ledges, where their nests, stick piles and runways may be seen by any one who will take the trouble to look for them. VERNON BAILEY.

GENERAL.

THE French Association for the Advancement of Science met at Tunis during the first week of the present month. M. Paul Dislère, in his Presidential address, reviewed navigation on the Mediterranean, beginning with ancient Carthage. M. de Bort, the Secretary, according to custom, described the previous meeting at Marseilles, losses by death, and honors conferred on members. M. Galante, the Treasurer, reported receipts for the current year amounting to 99,661 fr. and a reserve fund amounting to 1,190,100 fr. The meeting next year will be at St. Etienne.

THE American Medical Association, in conjunction with the American Academy of Medicine and other associations, meets this year at Atlanta, beginning on May 2d. Many papers and discussions, interesting not only to members of the medical profession, but also to other men of science, are announced.

AN examination of the recently published list of the *Deutsche chemische Gesellschaft* reveals some interesting statistics. Out of 3,020 members, 1,274 are from foreign countries. Of these the United States stand first with 261, and the United Kingdom a close second with 236. Then follows Austria, 175; Switzerland, 145; Russia, 124; France, 76; Holland, 75; Italy, 67, and Sweden, 28. Belgium, South America, Denmark, Japan, Norway, Finland and the East Indies follow with between five and ten; Canada, India, South Africa, Portugal, Roumania, Bulgaria, China, West Indies, Spain, Servia, Greece, Australia, New Zealand, Mexico, East Roumelia, Persia and Palestine are represented, the last four by a single member each. The Society might with justice claim to be international. Turkey is the only country in Europe with no member.

THE *Société Nationale d'Horticulture de France* will hold an international exposition from May 20–25, 1896. During that period an International Horticultural Congress will also be held to which the correspondents of the Society are invited to send delegates. Correspondence should be directed to M. Ernest Bergman, Secretary of the Commission for the organization of the Congress, 84 Rue de Frenelle, Paris.

AT the Berlin Industrial Exhibition to be held from the 1st of May to the 15th of October of the present year, there will be an international exhibition of astronomical photographs. Astronomers are requested to send to Dr. F. S. Archenhold, astronomer of the Grunewald Observatory, photographs, drawings of astronomical instruments and other objects suitable to the exposition. Dr. Archenhold will exhibit the new refracting telescope of the Grunewald Observatory, which is said to be the largest in Germany. This has two objectives, one of 170 and one of 110 cm. Instead of the usual dome, this telescope is provided with a cylindrical cover.

IT is announced that Prof. Schafer, of University College, London, is editing a text-book of physiology which will contain contributions by Professors Halliburton, Gamgee, Burdon Sanderson, Gaskell, Langley, Sherrington, McKendrick, Haycraft and others.

THE Swiss National Exhibition, which will be held at Geneva from May 1st to October 15th, will be especially noteworthy for the electrical exhibit, which, it is said, will be the finest ever made. Mr. Theodore Turretine, the Mayor of Geneva and President of the Exposition, is himself an electrical engineer.

THE Natural History Museum of London has acquired by purchase the collection of fossil bird remains from the reputed 'Eocene' beds of Santa Cruz, Patagonia, formed by Dr. F. Ameghino, of La Plata.

THE Pennsylvania Forestry Association held an unusually successful meeting at Philadelphia on April 10th. Addresses were made by Governor Hastings, Mayor Warwick, Provost Harrison, Mr. Fernow and Dr. Rothrock.

THE American Metrological Society is sending out a great many metric charts, pamphlets, petitions, etc., for the purpose of educating the people in regard to the salient points of the metric system, and those who understand the system are requested to write to their Representatives in Congress, urging them to vote for the Committee's Bill, a copy of which was published in this JOURNAL on March 27th.

IN a speech before the Senate in behalf of the bill providing for an additional fire-proof building for the U. S. National Museum, Senator Morrill stated that while the proposed building would suffice for the present to exhibit the accumulated specimens another and more elaborate building would be ultimately found necessary.

DR. WILLIAM SHARP, F. R. S., died at Llandudno, Wales, on April 10th, being 91 years of age. Dr. Sharp aided in the introduction of the teaching of science in schools and in the establishment of local museums throughout Great Britain. We regret also to record the death of Prof. Justus M. Silliman, for twenty-five years professor of mining engineering at Lafayette College, and of Dr. Charles Human, the German engineer and archæologist.

THE *British Medical Journal* states that the late Dr. W. C. Williamson, professor of botany at Owens College, Manchester, whose collection of specimens has just been purchased by the British Museum, left behind him an autobiography, which Mr. George Redway is about to publish under the title of 'Reminiscences of a Yorkshire Naturalist.'

MR. SEWELL has introduced into the United States Senate a bill providing for the establishment of a military and national park on the Palisades of the Hudson and making a preliminary appropriation of $500,000 for the purpose. The States of New York and New Jersey have agreed to cede jurisdiction over the Palisades to the United States.

THE French Geographical Society has awarded a gold medal to Dr. Louis Lapique for his voyage along the coast of Beloochistan and in the Persian Gulf, and more especially for his ethnographical researches on the Negritos.

THE *British Medical Journal* states that M. Renier has bequeathed to the Belgian treasury the sum of two million francs, to be applied to the foundation of a medical institute to be called the 'Institut Rommelaere.'

THE first serious treatment of American Mallophaga, or bird lice, is found in a paper just published conjointly by the Leland Stanford University and the California Academy of Sciences. In this paper Prof. V. L. Kellogg gives a table and synopsis of the genera and describes one new genus and 38 new American species, besides identifying 22 species previously described by European authors, but here, with few exceptions, first determined as parasites of American birds. For the first time in any work close attention is paid to immature forms as a contribution toward their almost unknown life history, and about 80 complete figures of bird lice are given, besides others of details of structure or portions of the body. It is sure to stimulate further investigation in a much neglected field.

A SERIOUS landslide is reported to have taken place at Trub, twenty miles east of Berne. A landslide is also said to have taken place at Bondesir, Saguenay county, Quebec.

PROF. W. WUNDT has been elected foreign associate and M. J. Lachelier member of the Paris *Institut* (Academy of Medical and Political Sciences).

THE provisional program of the International Congress of Psychology, to be held at Munich from the 4th to the 7th of August, announces 102 papers, and others will be announced later.

FELIX ALCAN announces as in press *La psychologie des sentiments* by Prof. Ribot and *Les types intellectuels* by Prof. Paulhan.

THE epidemic disease afflicting well meaning but ignorant people and leading them to see visions somewhat similar to those occurring in *delirium tremens* is not confined to America. A memorial with some 12,000 signatures has been presented to the Home Secretary of Great Britain and Ireland, claiming that there is not sufficient inspection under the act relating to vivisection. They state that two licensees had exceded the rights given them by their certificates.

ON April 5th, the first Sunday that the London National Museums were open to the public, there were 7,138 visitors at South Kensington Museum and 3,026 at Bethnal Green Museum.

DR. LEWIS SWIFT, of Lowe Observatory, California, has discovered a new comet. It is stated that its position was: Right ascension, 3 hours, 38 minutes and 26 seconds; declination, 18 degrees, 19 minutes, 32 seconds north on April 16th, 0.6896 Greenwich mean time. The comet is moving north at the rate of $2\frac{1}{2}$ degrees per day and very slowly westward. It is about as bright as a seventh magnitude star, and has a decided condensation in its head and a short tail.

DR. CH. WARDELL STILES, of the U. S. Department of Agriculture, has been elected a member of the French Academy of Medicine.

PROF. SEELEY, F. R. S., will begin a summer course of lecture excursions with the London Geological Field Class at the end of April. The subject of the series will be 'The Physical Geography and Geology of the Thames and its Tributaries.' This is the 11th annual course.

THE Boston Aëronautical Society, wishing to circulate its notices and reports, requests all those who are in any way interested in aërial navigation, to place their names on file, addressing the Secretary of the Society, Box 1197, Boston.

THE *Progressive Age* has published a report on experiments carried out by Prof. E. J. Houston and A. E. Kenelly to determine the actual cost of producing carbide of calcium at the works of the Wilson Company, at Spray, N. C.

WE learn from *The Lancet* that the Dean and Faculty of the Medical School of University College, Bristol, having consented to receive and permanently locate the valuable collection of momentos of Edward Jenner, known as the 'Jenner Relics,' it is desired to raise by public subscription the sum of £1,500 in order to defray the cost of purchase from Mr. Frederick Mockler, of Wotton-under-Edge. Each subscriber of one guinea and upwards will receive when the list is complete a silver medal, and to subscribers of not less than half a guinea a bronze medal will be presented, commemorative of the Jenner Centenary, May 14, 1896.

IN the summary report of the Canadian Geological Survey, Mr. Dawson calls attention to the entirely insignificant accommodation afforded by the present building for the work of the Survey. Not only are the offices inadequate and inconvenient, but the space available in the museum has become much too restricted, while both offices and museum, with all their valuable accumulations, are subject to danger of loss by fire. The advantage to Canada of having an adequate display of the mineral wealth of the country can scarcely be exaggerated, and that the museum, even in its present state, possesses much interest to the general public, is evidenced by the fact that more than 26,000 visitors have been registered during the year.

UNIVERSITY AND EDUCATIONAL NEWS.

YALE UNIVERSITY receives $200,000 through the marriage of Mrs. T. C. Sloane. Mr. Sloane had left part of his estate as a trust fund, the above amount to go to Yale University in case of Mrs. Sloane's second marriage.

THE will of the late Ephraim Howe leaves $40,000 to Tufts college for a new building to be known as the Howe memorial.

THE New York *Evening Post* states that the library of Cornell University has secured, by purchase, through the Sage endowment fund, the extensive collection of works on South America gathered, mainly during an eight years' residence in Brazil, by Herbert H. Smith, of the Brazilian Geological Commission.

IT is understood that Edinburgh University will receive £20,000 from the estate of the Earl of Moray as an endowment fund for the promotion of original research in the University.

THE Senate of the Glasgow University has conferred the degree of D. D. on Prof. Thiselton-Dyer and on Prof. Andrew Gray.

THE St. Petersburg Medical Academy has received from the Russian government $2,500 for experiments with the X-rays.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

EDITOR OF SCIENCE: I am very much afraid that physicists will find themselves utterly unable to follow, or, at least, to understand, Major Powell in his philosophical dissertations on the fundamental concepts of mechanics, and that they will be compelled to conclude that his philosophy is *not* 'Natural' Philosophy, in the generally accepted sense.

Believing this to be inevitable, it is hardly worth while to continue at any length a discussion or critical examination of the very interesting propositions which he has laid down. It may be of use, however, to invite his attention to the fact that in the answers to my questions relating to 'Rest and Motion,' which he gave in this JOURNAL for April 17th, he continues to ignore entirely the only serious issue raised by them. It can hardly be supposed that Major Powell is undertaking to establish a concept of motion independent of relativity, yet he seems to overlook the necessity of giving it consideration. When, in answer to my question, he defines motion as 'change of position' it only leaves the question where it was before, if not in even greater obscurity. 'Position' implies a relation; then motion implies a relation and cannot be predicated of any one of Major Powell's several orders of units.

His statement that "the speed of a particle is constant in reference to itself at different times" is meaningless, if the commonly accepted idea of motion is correct. If it is not correct, and that of Major Powell is, then—the bottom has dropped out.

As to his suggested correction of a typographical error in his previous statement relating to the velocity of light, if *molar* be substituted for *molecular* in that statement, it remains quite as astounding as before. I mention this only that he may note that apparently he has not detected the real absurdity involved. M.

APRIL 19, 1896.

IS THERE MORE THAN ONE KIND OF KNOWLEDGE?

"*My praise shall be dedicated to the mind itself. The mind is the man, and the knowledge of the mind. A man is but what he knoweth. The mind itself is but an accident to knowledge, for knowledge is a double of that which is. The truth of being and the truth of knowing is all one.*"—*Praise of knowledge.*

I am pleased to find in the current number of SCIENCE (April 3, 1896), that after seven months of irrelevant discussion on side issues, one of your readers (M. M.), has at last found the thesis of my article on Science and Poetry (SCIENCE Oct. 4, 1895,) worthy of consideration.

While I take issue with M. M., I thank him for this opportunity to give, once more, my reasons for the belief that is in me that there is only one kind of knowledge and but one way to acquire it.

I hope I may be permitted to say, in introduction, that I have no sympathy with those who hold that science is inductive or nothing. I yield to no one in reverence for mathematics. I wish it had been my good fortune to be more familiar with the deductive or 'abstract' sciences, for I believe they are the best products of the human mind. I am prepared to stake everything on their axioms, for I believe they are ἄξιοι, or worthy of all confidence. I accept the logical deductions from them as the best and most trustworthy of all knowledge.

All this is quite a different matter from the admission that these axioms rest on anything but evidence; that they are 'necessary;' or that we have any way to deduce new truth from them except the employment of that empirical *logic of events*, which is based on evidence and knowledge of the order of nature. I am acquainted with no evidence that the mind is anything more than 'an accident to knowledge,' or that knowledge is any thing but 'the double of that which is.'

In his comment on my assertion that *the test of truth is evidence* and nothing but evidence, M. M. admits that evidence is a requisite test for *nearly all* truths. I infer from this qualification that he believes there are some truths for which evidence is not necessary.

If this means that some truths are already supported by so much evidence that no more is needed, I have nothing to say; but I take it that he believes with Hume, that certain truths 'are discoverable by the mere operation of thought, without dependence on what is anywhere existent in the universe.'

His words are not very explicit; and if this is not his meaning I beg his pardon, and I ask leave to address this communication to those readers of SCIENCE, if any there be, who do believe in 'necessary truths.'

Like most students of the order of nature, I feel my own unfitness to contend in argument with one trained in dialectic, and I shall, therefore, attempt no more than a brief statement of what I believe to be the opinion of most of my scientific contemporaries concerning those conceptions which are called axioms, innate ideas, intuitive beliefs or necessary truths.

When we ask proof that these conceptions are innate we get no direct evidence, but we are told we must admit this, since we cannot conceive their contrary. As M. M. acknowledges that 'inconceivability is no test of falsity,' he, at least, cannot make this reply; for, if his words mean anything they mean that inconceivable things may be true. We have no way to discriminate between unknown things, and anything which may be true may some time prove true.

If there were any reason to believe the human mind is a finished instrument, perfect, and a measure of the unknown, the argument, that these beliefs are necessary because we cannot conceive their contrary, might seem valid; but no one who believes 'the subtilty of nature is far beyond that of sense or of the understanding' can admit that this proves they are necessary in any sense of the word except the practical one. We are able to spin fancies out of our minds as a spider spins silk out of its stomach, but I hope most readers of SCIENCE agree that "all this is but a web of the wit; it can work nothing." I hope they agree, also, that the difference between truth and fancy is evidence.

We say, glibly enough, of this quintessence of dust: "What a piece of work is man? How noble in reason! how infinite in faculties! in apprehension how like a god!" But it is perhaps fortunate for our self esteem that we have no opinion on the subject by any competent judge; and it is the height of folly to attempt to measure the unknown by our own minds.

We are told, furthermore, that reasoning is impossible unless these 'necessary' truths are admitted, and that, if they should ever cease to hold good, the result would be madness and destruction. This may be true, for all I know, but if the human race is ever overwhelmed in this way it will not be the first, for the rocks are filled with the remains of races which have been destroyed because their internal adjustments failed, at last, to correspond to the order of nature, after a long period of more or less perfect agreement.

There is no direct evidence that the conceptions in question are innate. The indirect evidence from the inconceivability of their negation is worthless, because of the imperfection of our minds. The statement that thought is impossible without them is no assurance that our race may not, like many races which have gone before, some time find itself where the old order changes. Finally the modern student finds still a fourth reason for questioning the necessity of these ideas; the fact that evidence is adequate to account for them, and that the assumption that they are innate is unnecessary.

"It is impossible to prove that the cogency of mathematical first principles is due to anything more than these circumstances; that the experiences with which they are concerned are among the first which arise in the mind; that they are so incessantly repeated as to justify us, according to the ordinary laws of ideation, in expecting that the associations which they form will be of extreme tenacity; while the fact that the expectations based upon them are always verified finishes the process of welding them together. Thus, if the axioms of mathematics are innate, nature would seem to have taken unnecessary trouble, since the ordinary process of association appears to be amply sufficient to confer upon them all the universality and necessity which they actually possess."

Your correspondent M. M. complains that my assertion, that the only test of truth is evidence, gives him 'a slight feeling of dizziness,' as if it were something radical and revolutionary. He may be interested to know that about 2500 years ago Heraclitus warned his fellowmen of the danger of seeking truth in their own little worlds instead of the great and common world, while Bacon gives more energetic expression to the same conviction in the following words:

"This is a rotten and pernicious idea or estimation that the majesty of man's mind suffers diminution, if it be long and deeply conversant with experiences. * *. And this opinion or state of mind received much strength from another *wild and unfounded* opinion, which held that truth is innate in the mind of man and not introduced from without, and that the senses rather excite than inform the understanding."

Most students of the principles of science admit that the mind of man has not yet attained to knowledge of causes, but that it has, so far, discovered nothing except a little of the order of nature. The reason why events, either mental or physical, occur in one order rather than another is a mystery which is absolutely unsolved. We can say no more of them than that "they appear together, but we do not know why."

If this is true it is clear that we are in no position to say of any event that it *cannot* be true in the absence of any other event. "The distinction between the necessary and the sufficient condition for the truth of a statement," which M. M. seeks to establish, has therefore no warrant in our knowledge of nature; for while we may seek to 'govern nature in opinion we are thrall unto her in necessity.'

Whether there be such a thing as *formal* logic, distinct from the empirical logic of events, or not, I believe my associates are pretty well agreed that all attempts to make practical application of formal logic have ended in failure. "The two ways of contemplation are not unlike the two ways of action commonly spoken of by the ancients; the one pleasant and smooth in the beginning and in the end impassable, the other rough and troublesome in the entrance but after a while fair and even. So it is in contemplation; if a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts he shall end in certainties.

"Once on a time there were two brothers. One was called Prometheus, because he always looked before him and boasted that he was wise beforehand.

"The other was called Epimetheus, because he always looked behind him and did not boast at all, but said humbly, like the Irishman, that he would sooner prophesy after the event.

"Well, Prometheus was a very clever fellow, of course, and invented all sorts of wonderful things, but, unfortunately, when they were set to work, to work was just what they would not do; wherefore very little has come of them, and very little is left of them; and now nobody knows what they were, save a few archæological old gentlemen who scratch in queer corners.

"But Epimetheus was a very slow fellow, certainly, and went among men for a clod, and a muff, and a milksop, and a slow coach and a bloke, and a boodle, and so forth. And very little he did for many years; but what he did he never had to do over again. Stupid old Epimetheus went working and grubbing on, always looking behind him to see what had happened, till he really learned to know now and then what would happen next, and understood so well which side his bread was buttered, and which way the cat jumped, that he began to make things which would work, and go on working too, till at last he grew as rich as a Jew and as fat as a farmer, and people thought twice before they meddled with him, but only once before they asked him to help them." W. K. BROOKS.

APRIL 8, 1896.

THE RETINAL IMAGE ONCE MORE.

I REJOICE to learn, in the current number of SCIENCE (April 3, 1896, p. 517), that C. L. F. does not include me with the '*Medical Society in Philadelphia*,' and the '*Prominent Baltimore Physician*,' among those '*Distinguished Scientists who think there is anything which needs explanation in the fact that the image on the retina is inverted;*' but as I know no reason why the readers of SCIENCE should rejoice with me, I do not care to dwell on the matter.

W. K. BROOKS.

ON THE DISAPPEARANCE OF SHAM BIOLOGY FROM AMERICA.

ALMOST exactly three years ago I contributed to SCIENCE* a paper entitled 'On the Emergence of a Sham Biology in America.' In this article I found it necessary to criticise severely the condition of things in some of the leading American universities where courses in zoölogy were permitted to masquerade under the larger title of *Biology*. I protested vigorously against the educational deception which, in at least one important institution—where the official announcement was made that only lack of funds prevented a proper development of botanical science—attempted to cover up this poverty by naming the courses in zoölogy courses in 'biology.' It was pointed out that much harm was done to true biological science by such ignoring of one-half of the science and professing that the moiety remaining was the whole.

Following this article of three years ago was a great outcry against my position from gentlemen professing to represent Johns Hopkins University and Columbia University in the columns of SCIENCE, but at the same time I received some half hundred letters of congratulation from both zoölogists and botanists, representing the leading institutions of the country from Harvard to California. In SCIENCE for May 26, 1893, I closed the discussion and waited for the outcome, for it was clear that attention to the matter had been excited.

Within a year Chicago University announced the withdrawal of its Department of Biology and the title of Dr. Whitman was changed from Head Professor of Biology to Head Professor of Zoölogy. Following this came the announcement of the creation of a Department of Botany at that institution, and one stronghold had fallen.

This year I learn that on March 2d the Trustees of Columbia University have changed the name of the Department of Biology to Department of Zoölogy, and have altered the titles of the staff to correspond. I am exceedingly gratified at this action which places Columbia upon the reasonable and honest basis. It now remains for the one important institution that is at the same time the greatest offender of all to awaken to its isolated and dishonest position and to cease sending out Doctors of Philosophy in Biology when the botanical work is still in the hands of a tutor and the preponderant stress is laid upon zoölogy. A full professorship of botany should be established at once, requiring no change in staff, but giving a fair recognition to both biological sciences and saving the institution from such spectacles as it had to witness three years ago when its 'biologists' stood up manfully for a sham biology that is now vanishing like mists in the morning.

CONWAY MACMILLAN.

*SCIENCE, Old Series, 21: 184. 7 Ap., 1893.

THE PREROGATIVES OF A STATE GEOLOGIST.

IT was with surprise that I noticed in a recent number of SCIENCE a communication on the 'Prerogatives of a State Geologist,' in which I am made the target of considerable unfair criticism. The temerity of its author, Mr. Erasmus Haworth, in distorting facts is not only a little astonishing, but smacks almost of deliberate endeavor to misrepresentation. Ordinarily it would not demand the slightest notice, but from the character of the presentation there might appear some plausibility to some of those who have no personal knowledge of the circumstances, of the animus of assault, or of the persons involved. I do not care to impose, even upon an indulgent public, an account of the various differences which have recently arisen between Mr. Haworth and myself. I only wish to make the statement, and that emphatically, that the charges made are either wholly false or are calculated to deceive. With the same data and by the same adroit manipulation of phrases and partial quotation it can be proved to the full satisfaction of the sunflower savant that the moon is made of green cheese. CHARLES R. KEYES.

COIN DISTORTIONS BY RÖNTGEN RAYS.

WE have repeated Professor Frost's interesting experiments on the distortion of coins (SCIENCE, N. S, Vol. III., No. 65, p. 465) in skiagraphs, but we have come to the conclusion that the distortion is due, not to electrostatic charges (as was suggested in the article referred to), but simply to umbras and penumbras formed by rays emanating from different points and falling upon coins of different thicknesses. In repeating Prof. Frost's experiments, we had the Crookes tube 14 mm. above the silver dollar and the film 3 mm. below the coins. We then placed the coins on a horizontal pane of glass and in the same position relative to the Crookes tube above them as when the skiagraph was taken. On holding a piece of paper up against the pane and examining by the eye, from below, the shadow cast by the coins in the light of the Crookes tube above, the very same distortion was seen that was shown in the skiagraph.

With the view of preventing X-rays having a large incident angle from striking the edges of the coins forming the curvilinear triangle, we placed upon the triangle a cylindrical section cut from the neck of a yellow-glass bottle. The section was ground down to a height of 11 mm., its internal diameter varied from 13 to 15 mm., its thickness was 5 mm. The distortion in the skiagraph was a trifle less than formerly, but more pronounced, we thought, than in the ocular test.

Fearing that the glass was somewhat transparent to X-rays, we replaced it by three iron washers superposed upon each other. Their internal and external diameters were 14 mm. and 34 mm. respectively, and their combined thickness was 9 mm. The tube, film and coins were in the same relative position as before. The skiagraph revealed much less distortion than in the first exposure. The ocular test with the washers on and with them off produced, as nearly as we could tell, exactly the same effects as were shown in the skiagraphs.

In another trial we discarded the washers and separated the coins from the film by only three thicknesses of black paper. The tube was again 14 mm. above the coins. As expected, the edges of the coins in the skiagraph were very sharp, and there was no trace of distortion. In this case the electrostatic charges must have been fully as pronounced as in the first experiment, but a perceptible penumbra could not have been formed. It would seem, therefore, that the distortion was due simply to umbras and penumbras cast by the coins.

FLORIAN CAJORI,
WILLIAM STRIEBY.

COLORADO COLLEGE,
April 10, 1896.

SCIENTIFIC LITERATURE.

THE ERUPTIVE SEQUENCE.

Die Eruptivgesteine des Kristianiagebietes II. Die Eruptionsfolge der triadischen Eruptivgesteine bei Predazzo in Südtyrol. Von DR. W. C. BRÖGGER. Videnskabsselskabets Skrifter, I. Mathematisk-Naturv. Klasse. 1895, No. 7. Kristiania.

After many years of exhaustive research

Brögger is now giving to science the results of his labors on the rocks of southeastern Norway in a series of memoirs of which the one before us is the second. Various preliminary papers and the classic monograph, *Die Mineralien der Syenitpegmatitgänge*, have stimulated petrologists to a keen anticipation of the magnificent contribution which should accrue to their science by the publication of Brögger's work. The first two memoirs amply justify these anticipations; and it is becoming apparent that the work will be an epoch-making event in the history of the science, and will result in the establishment, on a sure basis, of the principle of *magma differentiation* as one of the most important factors, if not the all-controlling factor in the genesis of rock types. Toward this principle, or rather toward a full comprehension of its scope, petrology has been groping rather vaguely for the last ten years, and we now seem to have arrived at a point when knowledge is beginning to crystallize from the all-pervading magma of ignorance. Among those prominent in contributing to the modern conception of differentiation Brögger is *facile princeps*, and it is fortunate for the science of petrology that a field so rich in possibilities of demonstration of the differentiation hypothesis should have fallen to the lot of so keen and masterful an investigator.

The subject-matter of the paper may be stated under the following heads:

1. The establishment of a new family of plutonic rocks, designated the *monzonites*.

2. A discussion of the eruptive sequence near Predazzo.

3. A discussion of the mechanism of plutonic eruption, involving

4. The proof of the laccolitic character of the plutonic rocks of the Christiania region.

5. A comparison of the eruptive sequence near Predazzo and Monzoni with that in the Christiania region.

6. The formulation and discussion of the law of plutonic sequence, involving

7. The discrimination between the sequence of plutonic and that of volcanic rocks.

A few words by way of summary and comment may be of service as indicative of the trend of thought in modern petrology.

The term monzonite has been used by different writers in various senses as a comprehensive and as a special designation for certain rocks occurring in the classic environs of Predazzo and Monzoni. The confusion arising from the various usages of the term is historically reviewed, and it is pointed out that, however various the usage, the rocks designated as monzonites have been, with one exception, by all writers, referred to the family of the Diorites, or plagioclase rocks, or to the Syenites, *i. e.*, orthoclase rocks. A review of the literature and of the rocks themselves leads Brögger to the view that the latter are properly to be classed with neither of these two families, but are characterized by approximately equal occurrence of both alkali feldspars and lime-soda feldspars. This being so, he claims for them recognition as a distinct family of plutonic rocks intermediate between those characterized by the prevalence of orthoclase (alkali feldspar) and those characterized by the predominance of plagioclase (lime-soda feldspar).

After an exhaustive review of the chemical characters of the monzonites and a discussion of their relations to other families of rocks, he formally defines them as an order of transition rocks between the orthoclase and the plagioclase rocks, of true plutonic character. They are of intermediate bacisity (SiO_2–49–62 per cent.), with a moderate lime contents (6–7 per cent.) and about the same contents of alkalies in equal proportion; high in alumina (17–18 per cent.) and relatively low in magnesia. Various subdivisions of the monzonites are recognized, such as *pyroxene-monzonite*, *hornblende-monzonite*, etc.

The establishment of the monzonites as a separate family of plutonic rocks as above defined is important in the emphasis which it places upon the inadequacy of the present scheme of classification to accommodate all rocks, and as expressive of a strong tendency among petrologists to expand the nomenclature.

The eruptive sequence near Predazzo and Monzoni is formulated as follows:

1. Oldest—Dykes and flows of basic rocks.

2. Corresponding to the latest of these are basic plutonic rocks.

3. More acid rocks—Monzonites, represented by volcanic flows of plagioclase porphyrite.

4. Biotite granite with contact facies of tourmaline granite.

5. Complementary dykes of camptonite and nepheline-bostonite-porphyry.

The discussion of the mechanism of plutonic eruption consists chiefly in a vigorous attack upon the 'assimilation hypothesis' of Michel-Lévy based upon its utter failure to explain the facts of the Christiania region. The assimilation hypothesis has much in common with a similar hypothesis put forward earlier by Kjerulf and involves the assumption that plutonic *massifs* have pierced the crust by a process of fusion of the region invaded and consequently of an absorption of a portion of the crust, thus explaining the common abutment upon these massifs of different stratigraphic horizons of the region invaded. Brögger combats this view, as it appears successfully, as applied to the Christiania region, and shows that the plutonic rocks have a laccolitic, and not a batholitic, relation to the Silurian strata which they invaded. This constitutes a very important advance in our conceptions of laccolites, the Christiania laccolite being by far the most extensive now known. The assimilation idea is disproved by the fact that although the igneous magmas invaded Silurian limestone, the analyses of the rocks show no enrichment of lime near the contacts; and the fact that the plutonic rocks transgress the ruptured edges of the Silurian strata, with the local absence of the lower members, is shown to be probably due to the fact that the latter underlie the laccolite and have not been absorbed by it. While the assimilation theory thus breaks down when applied to the Christiania region, it is by no means certain that it is not the true explanation of the origin of many other more extensive areas of plutonic rocks, as Brögger admits.

The essential features of the assimilation hypothesis were formulated by the reviewer some years ago, before the publication of Michael Lévy's views, and urged as a satisfactory explanation of the remarkable relations which obtain between the Laurentian granites and gneisses and the upper Archæan or Ontarian metamorphic rocks. These intrusive granites and gneisses occupy vast tracts of the Canadian Archæan plateau and there seems to be no escape from the view that they bear a batholitic relation to the crust which they invaded from below. Portions of the crust were absorbed, but there are two possibilities as to the method of absorption viz: 1. By fusion; 2. By sinking into the magma. The numerous blocks of rocks scattered through the granites lends much probability to the latter having played a part in the process. Such batholites were doubtless accompanied by laccolitic satellites.

In his comparison of the eruptive sequence in the Tyrol and Christiania regions Brögger finds an essential identity to the extent that the eruptive activity yielded first basic rocks, then those of intermediate acidity, then acid rocks and finally a reappearance of basic rocks in limited amount in the form of dykes.

The evidence bearing upon the sequence of plutonic eruption, drawn from the records of various well-known fields of geological research, is next placed in review and leads our author to the formulation of a general or normal law of sequence, which states, that plutonic rocks appear in any field in the order '*basic, less basic, acid.*' The sudden return to basic intrusions succeeding the acid is not sufficiently constant to warrant it being made part of so general a proposition. This law of succession is at variance with other attempts at the formulation of a general law, but all such former attempts have either been concerned with volcanic rocks solely, or have failed to discriminate between the volcanic and the plutonic. The necessity is urged of investigating the succession of these two classes of rocks separately. The discrimination will undoubtedly lead to an elimination of much of the confusion which exists in geological literature on these interesting questions.

In graceful compliment to American research, the volume is dedicated by its author to Prof. J. P. Iddings, of the University of Chicago.

Andrew C. Lawson.

Berkeley, March 11, 1896.

Electric Wiring. By Russell Robb. Macmillan & Co., New York. 183 pp., 76 cuts. Price, $2.50.

This book is intended for the use of architects, underwriters and the owners of buildings.

In the first and second chapters the author explains, in a very clear manner and in a non-technical language, the properties of wires carrying currents of electricity. The particular features treated are those which have a bearing on danger from fire and the proper proportioning of wires to avoid such danger. Chapter III. deals with the series, the multiple and the three-wire systems. There are excellent diagrams showing what these systems are, and the text explains how they are operated. Chapter IV. gives a brief account of methods of wiring, particular attention being given to the reasons which make the conduit system the most desirable for the better class of modern buildings. The remaining chapter gives the National code of rules for wiring as applied to Central Stations, High-Potential Systems, Low-Potential Systems, Alternating Systems, Electric Railways and Batteries. These rules are all quoted in full, and each rule is followed by a full explanation of the reasons for its adoption and the dangers which it is the object of the rule to avert. The rules contain many technical words which are explained. It is evident that this is the kind of information which will conduce to the more general carrying out of these rules in practice. The house owner will see that they are designed to protect this property, and not simply to annoy him by useless restrictions. The book is well-written and contains information that no house owner can afford to ignore if he is called upon to deal with electric wiring.

FRANCIS E. NIPHER.

SCIENTIFIC JOURNALS.

THE AUK.

THE *Auk* for April is a number of rather more than usual interest. The opening article, by William Palmer, 'On the Florida Ground Owl (*Speotyto floridana*),' treats in detail of the peculiar distribution and breeding habits of this hitherto little known species, and is illustrated by a colored plate of the bird, a diagram of one of its breeding sites, and a cut showing in section one of its burrows. Mr. F. A. Lucas writes of 'The Taxonomic Value of the Tongue in Birds,' illustrated with figures of the tongue in 12 species, showing the relation of its structure to the food habits in different groups of birds.

Miss Florence A. Merriam has interesting 'Notes on Some of the Birds of Southern California,' and the well-known artist, Abbott H. Thayer, has a very suggestive paper on 'The Law which Underlies Protective Coloration,' with cuts in the text and five full-page photographic illustrations. In short, Mr. Thayer's newly discovered law is to the effect that 'animals are painted by nature, darkest on those parts which tend to be most lighted by the sky's light, and *vice versa.*' This is illustrated by a series of ingenious experiments with the Ruffed Grouse and Woodcock, showing that when the darker 'protective' tints of the upper surface are artificially extended over the lighter lower parts the bird becomes 'completely unmasked.' The artificial extension of the top colors over the lower parts destroys the counter-gradation of colors imposed by nature and forces the bird's solidity to manifest itself.

Dr. Louis B. Bishop describes a new Song Sparrow and a new Horned Lark from North Dakota, and George K. Cherrie a new Nighthawk from Costa Rica. Witmer Stone publishes a revision of the North American Horned Owls, describing also a new species. Some sixteen pages are devoted to a critical examination, by J. A. Allen, of Gätke's 'Heligoland as an Ornithological Observatory, the Result of Fifty Years' Experience'—a book that has attracted wide attention and in general has received high praise. Mr. Allen, however, shows that its merits have been often greatly overrated, and its faults either wholly overlooked or very leniently mentioned. While 'Heligoland' is an important contribution to the literature of ornithology, "it contains much that is set forth as fact which proves on close examination to be mere conjecture." This is especially true of Chapter IV., on the 'Velocity of the Migration Flight,' where, on very slight evidence and in opposition to an abundance of rebutting testimony, it is claimed that most birds perform under normal conditions their migratory journeys in 'one uninterrupted nocturnal flight, * * accomplishing a distance of at least 1,600 geographical miles within the space of nine hours.' He even considers that the Red Spotted Blue-throat (*Cyanecula suecica*) may make the journey from Northern Africa to the Scandinavian Peninsula—a distance of 2,000 to 2,400 geographical miles—during a single May night, giving a velocity of four miles a minnte, or 240 miles an hour! The American Golden Plover, he affirms, migrates in autumn from Labrador to Brazil—a distance of 3,000 miles—in a single uninterrupted flight, going at an average rate of '212 geographical miles per hour.' As he offers nothing but negative evidence and conjecture in proof of these statements, they are scarcely entitled to serious notice, so contrary are they to all of the known evidence bearing on the case. In Chapter VI., on the 'Order of Migration According to Age and Sex,' the evidence in support of his thoory that "the autumn migration is initiated by the young birds, from about six to eight weeks after leaving the nest," does not well bear close analysis. But the worst portion of his book is the fourteen pages relating to 'Changes in the Colour of the Plumage of Birds without Moulting,' in which he asserts that the breeding dress in many birds is acquired by a change in the color of the feathers themselves without any alteration or change in their texture, whereby pure white feathers change to dark brown or black; and not only this, but the worn jagged edges of the old feathers at the same time are restored to their former size and evenly rounded outline, so as to look in reality like new feathers. As a matter of fact, the very species he cites and describes in detail as undergoing this wonderful process are well known to acquire their breeding dress by a spring molt! In view of these and other misstatements the review closes with the following: "With all its imperfections 'Heligoland' is a book of great interest and value, Part III. being a particularly useful contribution to the literature of ornithology. It is also a work that is likely to do much harm, for it is its sensational and inaccurate parts especially that find their way into the current literature of the day, and particularly into magazines and books devoted to the popularization of natural history."

The department of 'Recent Literature' contains the usual complement of reviews of leading works and papers on ornithology, and the department of 'General Notes' some thirty brief notices of rare or little known species, relating mainly to their occurrence at unusual or entirely new localities. Under the heading 'Correspondence' some ten pages are devoted to the discussion of various questions of nomenclature, by Witmer Stone, H. C. Oberholser and the editor, the number concluding as usual with several pages of 'Notes and News.'

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON, MARCH 28.

Mr. Charles Richard Dodge read a paper on some undeveloped American fibers. He stated that government experiments for the development of fiber industries in different countries date back nearly one hundred years. A necessity for such government aid is the importance of securing disinterested experts to prosecute the work, that the investigations and experiments may be conducted in a scientific manner. Such experiments relate to the testing of the strength of fibrous substances, the testing of new machines or new chemical processes for their preparation, and the cultivation of fiber plants when necessary to demonstrate their precise economic value.

In the United States 15 commercial fibers are recognized, only four of which are produced to any extent within our borders: cotton, hemp, palmetto and Spanish moss. The commercial forms not grown, but which might be produced in this country, are flax, jute, sisal hemp, New Zealand flax, cocoanut and possibly sunn hemp.

There are many other forms of plants, some of them classed as American weeds, which produce fibers known as jute or hemp substitutes, that it will not pay to cultivate while the standard fibers hold the market. These are chiefly bast fiber plants.

The flax industry is being reëstablished in this country, on the lines of an 'American practice' laid down by the Department of Agriculture, and gratifying progress has already been made in the new industry. Sisal hemp and some alleged forms of structural fiber plants will thrive in southern Florida. Ramie culture and the spinning and manufacture of the fiber are no longer problems, though the world waits for a successful machine to clean the fiber for market.

There are many hundreds of fiber plants in the world, and the fiber expert is constantly asked to give information concerning the more promising species, not always with a view to cultivation, but often that useless expense in experimentation may be avoided through proper knowledge of their value. The question to be asked in considering a new form of fiber is not "Can we grow the species?" but "What commercial fiber will it compete with, or become a substitute for?" With a definite knowledge of the subject, as it relates to the fibers of the world, the expert need never be in doubt regarding the economic value of any species that may be submitted to him for an opinion.

The commercial fibers represent, in a sense, the survival of the fittest, and until these are crowded out by new conditions there is little chance for the other fibers, unless a particular species is found adapted to some new and special use for which the standard forms are not available.

The second paper was on *Geographic Names* by Henry Gannett.

BERNARD R. GREEN,
Secretary.

APRIL 11, 1896.

MR. S. P. LANGLEY read a paper on 'More recent observations in the infra-red spectrum.'

He referred to a communication to the Society more than two years ago, in which the expectation was held out of an early publication of a map of the infra-red spectrum made by the bolometer, and he desired to explain some of the difficulties which had caused its delay.

It was the misfortune of the astro-physical observatory here that appropriations for its maintenance were made in such a form that a proper building could not be erected in some site free from tremor, and under circumstances providing against local disturbance. As had already been stated in official reports, such local causes had introduced numerous errors in the record, in the form of tremors and oscillations in the photographic trace of the movements of the needle controlled by the bolometer, which it was almost impossible to exclude in the present installation. The linear spectra which had been shown here and before the British Association were all produced by a nearly automatic process, the minutest line in the spectrum implying a corresponding minuteness in the original curve; and in this connection he desired to call attention to the statement in a previous report, to the effect that all the minuter details, such as had been shown here and at Oxford, had not been verified; and to the fact that illustrations of the minuter detail in linear form were given at that time, with the caution that they were presented 'only in illustration,' and were 'not to be treated as a criterion of the final results.'

The amount of local error is roughly proportional to the minuteness of the detail sought. Thus, in the spectrum shown here, and later at Oxford, giving the leading lines discovered by the new method, nearly everything has stood the test of subsequent investigation; while of the minuter detail in the curves of which a linear translation was then given, in illustration of the process, a large proportion had been subsequently found to lie under suspicion.

The extent to which the character of the work had been influenced by these local conditions having been more and more recognized, the labor of the past two years had consisted largely in weeding out errors arising from them, and the process had involved the slow reconstruction or modification of nearly every portion of the apparatus, with special reference to the difficulties imposed by the site and the insufficient installation.

Details of the new apparatus were then given with lantern illustrations, particular attention being directed to the introduction of the system of suspending the galvanometer so that ground tremors were not conveyed to it, or were conveyed in diminished intensity, a change which was stated had been a most essential improvement, and which had done away, not entirely, but more than might have been thought possible, with the inconveniences of a site surrounded by city traffic.

Many bolographs had been taken during the past year, but only within the past months had the apparatus been brought to such a condition that the local causes of error were diminished to a degree consistent with the desired standard of accuracy. In illustration of the difficulties overcome, it was stated that while a current passing through the bolometer is something like $\frac{1}{10}$ ampere, and while a current of less than $\frac{1}{100}$ millionth part of this will cause a deflection of a millimeter on the scale, no such deflection was visible in the automatic trace shown in illustration. The bolometer was nearly as sensitive at the time of the last communication as it has been made since, and the work of the past two years has lain in guarding this sensitiveness against local causes of error, so that it shall be engaged in legitimate service, and respond only to a message from the sun. The speaker trusted that the final results of this labor would soon be made public, and concluded by renewing a statement of his obligation to those gentlemen who had been previously connected with the work, and by an expression of his indebtedness to Messrs. Abbot, Child and Fowle, who are associated with its present development.

MR. E. D. PRESTON read a paper on French, German and English systems of shorthand writing, in which he gave a brief review of shorthand writing from the time of the ancient systems down to the present day. The principles underlying the art were illustrated by examples from the French (Duployé) German (Gabelsberger) and English (Pitman). A comparison was made with reference to accuracy and rapidity in the three cases. Special contractions depending on the particular language employed were also illustrated. As a further test in order that no advantage should be given to either, each of the systems was applied to a strictly phonographic tongue (Polynesian) outside of the Indo-European family of languages. The conclusion was that English shorthand is the most philosophical, the French the simplest, and the German the most vigorous.

MR. R. A. HARRIS, of the U. S. Coast and Geodetic Survey, read a paper the objects of which were "To show in a non-mathematical way what simple oscillations go to make up the complex tidal wave; to give a short account of the harmonic treatment of tides, and to describe briefly certain mechanical aids which are, or may be, used in connection with the analysis and prediction of tides."

The principal tidal components were pointed out by considering what their 'speeds' must be in order to cause them to gain or lose one oscillation on a component having a 'speed' equal to the apparent diurnal motion of the moon or sun, or twice this motion, after the the lapse of certain times, as a tropical month or year, an anomalistic month or year, a half tropical month or year, a half synodical month, etc.

A sample was shown of the perforated sheets devised by Mr. L. P. Shidy, of the Survey, and styled 'stencils,' which have been in constant use for upwards of ten years. They indicate how the hourly heights are to be combined in the various kinds of summation, and so do away with the necessity of copying and recopying the tabular values.

A design of an adding apparatus to be governed by a stencil sheet embracing, side by side, all components to be summed for was shown. This, if constructed, would enable a person to sum simultaneously for all components almost as rapidly as for a single one upon an ordinary adding machine. The stencil sheet does away with the necessity of the great variety of gears (representing 'speeds') found in the Thomson harmonic analyzer, and insures positive workings. In fact, there are but two kinds of gear wheels in the adding apparatus, one containing, say, 300 teeth each, and the other, serving as counters, containing 299. The number of wheels in each of these two sets is 24 times the number of components to be summed for. Each 54 partial sums thus obtained are then to be analyzed in the usual way.

Brief mention was made of the predicting machines already constructed, and comparisons were made with the one now being built by the Survey.

BERNARD R. GREEN,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

THE meeting of this Society of April 8th was devoted to a general discussion of the subject of the application of stratigraphy and paleontology in determining subdivisions of geologic time.

The broad problems involved in the announced topic were primarily presented by Mr. Whitman Cross in a concrete case. He described the present state of knowledge regarding the formations of the Rocky Mountain region belonging to the periods between the Marine Cretaceous and the Wasatch Eocene, including the Laramie, Arapahoe, Denver, Ft. Union and Puerco. The statigraphic relations as at present known were described, and then the facts of the fossil floras, the invertebrate and the vertebrate faunas, were summarized. From the facts given it appears that the geologist investigating the formations of the group named is confronted by much conflict of evidence as to the relative importance of the time intervals separating the epochs of sedimentation. This is especially true in respect to the drawing of a line between the Mesozoic and Cenozoic in this region. The conflict of evidence in this instance was cited to show the necessity for a careful examination as to the nature of the connection between great faunal changes and the contemporaneous events of stratigraphic history. It appears that all forms of life were able to survive the period of great orographic disturbance at the close of the Laramie proper without radical change and that the dominant vertebrate life of the Post-Laramie disappeared at the close of that epoch from causes as yet unknown, which did not affect in any corresponding degree the contemporaneous plant and invertebrate life.

Mr. F. H. Knowlton presented a review of the fossil floras of the Laramie, Arapahoe, Denver and Fort Union formations, showing the strong distinctive characters of each and also their intimate relationship. This evidence fails to indicate any one break of supreme imimportance in this series of epochs.

Mr. T. W. Stanton reviewed in a similar manner the known invertebrate life of the upper Cretaceous and lower Eocene deposits of the Rocky Mountain region. The termination of true marine conditions was deemed to be the only safe criterion from this evidence to be applied in drawing a boundary for Mesozoic time.

A comparison of the vertebrate faunas of the Post-Laramie, Puerco and Wasatch formations, by Prof. W. B. Scott, of Princeton, was read by Mr. Cross. This brought out the remarkable differences in the vertebrate life of the three epochs, and also the impossibility of explaining the abrupt changes in these faunas from our present knowledge of attendant conditions.

Mr. F. V. Coville gave a review of the conditions affecting the distribution and changes in *living* floras, starting with the great controlling factors, heat and moisture, and making suggestions as to the applicability of these data to geological history.

Dr. C. Hart Merriam similarly described the conditions most affecting the distribution or causing modifications of terrestrial vertebrate life of the present, and discussed the apparent application of these facts to the past.

Mr. Bailey Willis referred to the variable relations which might exist between angular unconformity and otherwise important stratigraphic breaks.

Mr. R. T. Hill briefly referred to the development of knowledge of the Lower Cretaceous series of Texas, to which he had given twenty years' study, and brought out facts that bore in a general way on the subject under discussion.

W. F. MORSELL.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 248th regular meeting of the Society was held April 7, 1896.

Dr. Arthur MacDonald read a paper entitled *Psycho-Neural Measurements of Human Beings with Illustrations and Experiments.*

Introduction: Philosophy in the old sense is almost impossible; no one man can have sufficient insight into the different sciences to understand their relations and make judgment of their content. Specialism may narrow a man, but it deepens his knowledge. Knowledge is so dovetailed together that a specialty studied thoroughly necessitates the investigation of the nearest lying branches. Generalism is liable to be superficial. The habit of studying one thing thoroughly is the method of specialism and is directly practical. The desire to include the universe may be called *generalism.*

Facts about the nervous system of man are as important as facts about stones, plants and animals; yet there is, perhaps, the least definite knowledge about man. The scientific study of man in an experimental way is in its beginning. A man should *investigate* fifty times as much as he *writes*, and not *vice versa*.

Breathing.—Experiments with Ludwig's kymographion, the pneumograph and the Cambridge tambour, as made by Dr. MacDonald on four school children and three adults, seemed to indicate that concentration of mind or emotion lessens breathing. The effect between pathetic and lively music is noticeable.

Circulation.—In a somewhat extended experiment on a reporter with his newly constructed plethysmograph Dr. MacDonald found that: (1) By applying the algometer to the temporal muscle there was a decrease of flow of blood in the arm. (2) By passing a galvanic current through the brain, causing a pain like the prick of a pin, the effect was a decrease of flow of blood in the arm.

Fatigue.—By experiments on two women and two men with Mosso's Ergograph the results of Lombard were confirmed, to wit, that the recovery of the power of the finger after fatigue owes its periodicity to fatigue.

Dr. MacDonald illustrated with instruments of his own and those of others quantitative measurements of sensibilities of smell, heat, locality, pain and muscular judgments.

The second paper was by Dr. Thos. Wilson on 'Marriage in Nature and in Law.'

J. H. MCCORMICK,
General Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, APRIL 7, 1896.

THE Mineralogical and Geological Section having precedence, M. Jos. Willcox described the process of obtaining quartz from the Oriskany sandstone of Pennsylvania to be used in the manufacture of glass. Mr. Keeley stated that the bed used for the purpose extends southward through Bedford county, where the material can be used without crushing, as it crumbles when exposed to the air.

Prof. Carter suggested the use of stone from the Conshohocken quarries as a source of silica. When dissolved in hydrocholic acid the stone yields flattened, transparent grains of silica, not at all colored by iron. The percentage of mica is small, the glistening appearance of the rock being due to the presence of silica.

Mr. Geo. Vaux, Jr., called attention to recent additions to the William S. Vaux collection, which included superb crystals of calcite from the Joplin region, Missouri. They occur in caves opened for the working of lead and zinc. The several mines are characterized by distinct forms of the mineral. The sphalerite which is largely present is being desited at the present time, the handles of shovels and picks left in the mines being covered with crystals. Unfortunately these had all been thrown into the reducing furnace and destroyed.

Mr. Theodore D. Rand described a fine collection of polished serpentines presented by him to the Academy from numerous localities in southeastern Pennsylvania. They belong to two groups: one bordering the ancient gneiss, the other, and the more recent, occurring in the mica-schists and gneisses. The former are altered igneous rocks, either chrysolitic or pyroxenic, the chief material being enstatite. The sources of the several forms were traced.

Dr. Florence Bascom reported the microscopic examination of thin sections of serpentine from the Black Rocks of Lower Merion. The mineral from this localit has been derived from crysolite. That from the Conshohocken dyke is composed of diabase having the feldspar crystals in the lath-like form characteristic of that rock.

It was announced that Mr. G. Frederic Russell, accompanied by Dr. Querch and a taxidermist, had started from Georgetown, British Guiana, March 11th, on a collecting tour in the interior for the benefit of the Academy.

EDWARD J. NOLAN,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES, SECTION OF ASTRONOMY AND PHYSICS.

AT the regular meeting, held on April 6, 1896, the following program was presented before the section, Prof. J. K. Rees presiding:

The first paper was by Mr. P. H. Dudley, on the following title: 'The Law of Deflection Sets Under Drop Tests in Different Sections of

Steel Rails of Uniform Physical Properties Follows the Comparative Moments of Inertia of the Respective Sections.' Mr. Dudley described the improvements in the manufacture of steel rails which has been carried out under his direction during the last five years. The object was to produce a much stiffer rail than that which had been previously employed, and at the same time to make one out of a higher grade of steel. The rails have now been in use several years on the Boston & Albany and New York Central railroads, and they show a marked improvement over the old patterns in that the deflections have been decidedly lessened. Careful records of them have been kept by means of Mr. Dudley's track inspection machine. A great deal of information has also been accumulated by Mr. Dudley in connection with the tests of samples from each heat of steel in the process of manufacture. The full paper will be subsequently published by the Academy.

In the absence of Prof. Jacoby the contents of his paper on 'The Permanence of the Rutherfurd Photographs' were briefly summarized by Prof. Rees. Recent and very careful measurements made upon Rutherfurd negatives, which had been developed twenty or thirty years ago and which had been measured five to ten years ago, show absolutely no change in the plates, so far as could be detected. The film remains in the same part of the glass as when first studied. The negatives were made upon wet plates, and the speaker remarked that it remains to be shown whether the newer dry plates afford the same permanence.

The next paper was by Prof. J. K. Rees, on: (1) 'The Harvard College Observatory photographs of star clusters, planets, variable stars and stellar spectra.' (2) 'Prof. J. E. Keeler's photographs of planetary spectra.' Prof. Rees exhibited a large series of photographs of various astronomical subjects, which had been loaned by Prof. Pickering, of the Harvard Observatory, for the recent exhibition of the New York Academy of Sciences. He also threw upon the screen, by means of the lantern, a series of photographs of star clusters which included variable stars, and which show these variables at different periods. The originals were taken at the Harvard Observatory.

In the second part of his paper Prof. Rees threw upon the screen enlargements from photographs of stellar spectra which had been taken by Prof. Keeler, of the Observatory at Allegheny, Pa. The photographs of the spectra of Saturn were also shown, which prove that the ring about the planet is due to a stream of meteorites.

The last paper of the evening was the following by Prof. M. I. Pupin: 'Communication of some new Results of Experiments with the Röntgen rays.' This paper was printed in full in Science. April 10. Experimental demonstration of the points advanced was subsequently made for the members of the Academy in Prof. Pupin's laboratory.

J. F. Kemp,
Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

At the meeting of March 6th, Dr. Marcy in the chair, papers were presented by the Department of Mathematics.

Prof. Holgate gave the 'Problem of the Eight Queens,' which is so to place eight queens on a chessboard that no one will be endangered by any other, or, in general, to place n pieces on a square board so that no two will be in the same row, same column, or same diagonal. This problem was first proposed by Nauck to Gauss, was the subject of correspondence between Gauss and Schumacher and was finally solved by Gauss in 1850. In 1874 Günther suggested a solution of which Glaisher made use in a solution which he published that year in the Philosophical Magazine. Dr. Holgate presented Glaisher's solution in full.

Prof. White presented Poncelet's problem concerning polygons that possess both an inscribed and circumscribed conic. The parametric representations of the points of a conic, the doubly quadric relations of pairs of points, and the statement of periodic relations of this kind by the aid of elliptic functions, were treated in the manner of Euler, Jacobi and Hurwitz.

A. R. Crook,
Secretary.

Evanston, Ill.

Erratum:—On page 604, paragraph 2, line 2, for *Instinct* read *Insect.*

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ANNUAL MEETING OF THE NATIONAL ACADEMY OF SCIENCES.

THE annual meeting of the *Academy* was held in Washington on April 20, 21, 22, 23 and 25, Prof. Wolcott Gibbs, President, in the chair. The following members were present: Cleveland Abbe, Washington; Carl Barus, Providence; A. Graham Bell, Washington; John S. Billings, U. S. N.; Lewis Boss, Albany; Henry P. Bowditch, Boston; W. H. Brewer, New Haven; W. K. Brooks, Baltimore; E. D. Cope, Philadelphia; S. F. Emmons, Washington; Wolcott Gibbs, Newport; G. K. Gilbert, Washington; Theodore N. Gill, Washington; G. Brown Goode, Washington; B. A. Gould, Cambridge; Arnold Hague, Washington; Asaph Hall, Washington; C. S. Hastings, New Haven; G. W. Hill, West Nyack, N. Y.; Alpheus Hyatt, Boston; O. C. Marsh, New Haven; A. M. Mayer, Hoboken, N. J.; R. Mayo-Smith, New York; T. C. Mendenhall, Worcester, Mass.; A. A. Michelson, Chicago; E. S. Morse, Salem; J. W. Powell, Washington; F. W. Putnam, Cambridge; Ira Remsen, Baltimore; W. A. Rogers, Waterville, Me.; Ogden N. Rood, New York; H. A. Rowland, Baltimore. Charles S. Sargent, Cambridge; Charles A. Schott, Washington; Samuel H. Scudder, Cambridge; William Sellers, Philadelphia; A. E. Verrill, New Haven; Francis A. Walker, Boston; W. H. Welch, Baltimore; Charles A. White, Washington; A. W

Wright, New Haven. Forty-one members were present in all, nine more than at the preceding annual meeting.

In accordance with the recommendations made at the preceding meeting, the mornings were reserved for business, and the scientific sessions were held in the afternoon, the papers being arranged so that as far as possible those upon kindred topics should follow one another. The papers entered to be read were as follows:

I. *The Geological Efficacy of Alkali Carbonate Solution*, E. W. HILGARD.

II. *On the Color Relations of Atoms, Ions and Molecules*, M. CAREY LEA.

III. *On the Characters of the Otocœlidæ*, E. D. COPE.

IV. *Exhibition of a Linkage whose motion shows the Laws of Refraction of Light*, A. M. MAYER.

V. *Location in Paris of the Dwelling of Malus, in which he made the discovery of the Polarization of Light by Reflection*, A. M. MAYER.

VI. (1) *On Experiments showing that the X-Rays cannot be Polarized by passing through Herapathite.*

(2) *The Density of Herapathite.*

(3) *Formulæ of Transmission of the X-rays, through Glass, Tourmaline and Herapathite*, A. M. MAYER.

VII. *On the X-Rays from a Statical Current produced by a Rapidly Revolving Leather Belt*, W. A. ROGERS and FREDERICK BROWN.

VIII. *Biographical Memoir of James Edward Oliver*, G. W. HILL.

IX. *Biographical Memoir of Charles Henry Davis*, C. H. DAVIS.

X. *Biographical Memoir of George Engelmann*, C. A. WHITE.

XI. *Legislation Relating to Standards*, T. C. MENDENHALL.

XII. *On the Determination of the Coefficient of Expansion of Jessop's Steel, between the limits of 0° and 64° C., by the Interferential Method*, E. W. MORLEY and W. A. ROGERS.

XIII. *On the Separate Measurement, by the Interferential Method of the Heating Effect of Pure Radiations and of an Envelope of Heated Air*, W. A. ROGERS.

XIV. *On the Logic of Quantity*, C. S. PEIRCE.

XV. *Judgment in Sensation and Perception*, J. W. POWELL.

XVI. *The Variability in Fermenting Power of the Colon Bacillus under different Conditions.* By A. W. PECKHAM. (Presented by J. S. BILLINGS.)

XVII. *Experiments on the Reflection of the Röntgen Rays*, O. N. ROOD.

XVIII. *Notes on Röntgen Rays*, H. A. ROWLAND.

XIX. *Some studies in Chemical Equilibrium*, IRA REMSEN.

XX. *The Decomposition of Diazo-compounds by Alcohol*, IRA REMSEN.

XXI. *On Double Halides containing Organic Bases*, IRA REMSEN.

XXII. *Results of Researches of Forty Binary Stars*, T. J. J. SEE.

XXIII. *On a Remarkable New Family of Deep-sea Cephalopoda and its bearing on Molluscan Morphology*, A. E. VERRILL.

XXIV. *The Question of the Molluscan Archetype, an Archi-mollusk*, A. E. VERRILL.

XXV. *On some Points in the Morphology and Phylogeny of the Gastropoda*, A. E. VERRILL.

XXVI. *Source of X-Rays*, A. A. MICHELSON and S. W. STRATTON.

XXVII. *The Relative Permeability of Magnesium and Aluminum to the Röntgen Rays*, A. W. WRIGHT.

XXVIII. *The State of Carbo-dioxide at the Critical Temperature*, C. BARUS.

XXIX. *The Motion of a Submerged Thread of Mercury*, C. BARUS.

XXX. *On a Method of obtaining Variable Capillary Apertures of Specified Diameter*, C. BARUS.

XXXI. *On a New Type of Telescope Free from Secondary Color*, C. S. HASTINGS.

XXXII. *The Olindiadæ and other Medusæ,* W. K. BROOKS.

XXXIII. *Budding in Perophora,* W. K. BROOKS and GEORGE LEFEVRE.

XXXIV. *Anatomy of Yoldia,* W. K. BROOKS and GILMAN DREW.

XXXV. *On the Pithecanthropus Erectus from the Tertiary of Java,* O. C. MARSH.

Prof. H. P. Bowditch was elected a member of the council in the place of Prof. G. L. Goodale, who asked to be relieved from the duties of the office. Charles D. Walcott, director of the United States Geological Survey, and R. S. Woodward, Professor of Mechanics in Columbia University, were elected members of the Academy. The death was announced of Gen. Thomas L. Casey, U. S. A. There are now eighty-nine members of the Academy, eighty-three members have died since its foundation in 1863.

During the meeting of the Academy the committee appointed at the request of the Secretary of the Interior to report on a forestry policy for the government held several sessions. Members of the Academy appeared before the Senate committee having charge of the bill to fix the standard of weights and measures by the adoption of the metric system. Profs. Ira Remsen, John Trowbridge and G. J. Brush were appointed delegates to attend the sesqui-centennial celebration of Princeton Univ. A reception was given to members of the academy and invited guests by Mr. and Mrs. Arnold Hague on the evening of April 22d.

The autumn meeting of the Academy for the reading of scientific papers will be held in New York, beginning November 17th.

GEOLOGIC ATLAS OF THE UNITED STATES.

FOLIO 2, RINGGOLD, GEORGIA–TENNESSEE, 1894.

This folio consists of 3 pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1 : 125,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

Geography.—The district of country covered by this folio lies mainly in Georgia, a narrow strip about a mile in width along its northern border extending into Tennessee. It embraces portions of Dade, Catoosa, Walker, Whitfield, Chattooga, Floyd and Gordon counties in Georgia, and of Madison, Hamilton and James counties in Tennessee. The region forms a part of the great Appalachian Valley. Its surface is marked by three distinct types of topography, viz.: plateaus, formed by hard rocks whose beds are nearly horizontal; sharp ridges, formed by hard rocks whose beds are steeply inclined ; and level or undulating valleys, formed on soft or easily eroded rocks. The plateaus are confined to the western third of the district and include portions of Lookout and Sand Mountains. Their surface is generally level or rolling, with a slight inclination from the edges toward the center, giving the plateau the form of a shallow trough. They are bounded by steep escarpments rising from 1,000 to 1,200 feet above the surrounding valleys. The sharp ridges are confined to the eastern third of the district, while a broad undulating valley occupies its central portion. The latter is drained in part northward by tributaries of the Tennessee, and in part southward by streams flowing directly to the Gulf. The divide separating the two drainage systems is broad and low, and there is evidence that the Tennessee River formerly flowed southward across the divide.

Geology.—The rocks appearing at the surface within the Ringgold district are entirely of sedimentary origin and include representatives of all the Paleozoic groups. The oldest rocks exposed are shales, sandstones and thin-bedded limestones of lower and middle Cambrian age. These are called the Apison shale, Rome sandstone and Conasauga shale. Above these formations is a great thickness of siliceous magnesian limestone, the Knox dolomite, the lower portion probably being Cambrian and the upper portion Silurian. The remaining Silurian formations are the Chickamauga limestone and the Rockwood sandstone. The Devonian is either wholly wanting or is represented by a single thin bed of carbonaceous shale, not over 35 feet in thickness. Above the Chattanooga black shale are the Fort Payne chert, Floyd shale and Bangor limestone forming the lower Carboniferous, and the Lookout and Walden sandstones forming the Coal Measures. Most of the formations thicken eastward, and at the same time the proportion of calcareous matter decreases, showing that the land from which the materials composing the rocks were derived lay to the east.

The region has been subjected to compression in a northwest-southeast direction, and the originally horizontal strata have been thrown into a series of long, narrow folds, whose axes extend at right angles to the direction of the compression, or northeast and southwest. The effects of compression were greatest in the eastern portion of the district, where the strata are now all steeply inclined and the basal beds form sharp ridges, while in the western portion considerable areas of strata remain nearly horizontal and form plateaus. Where the folding was greatest there was also much fracturing of the rocks, and the strata on the eastern side of a fracture are in many places thrust upward and across the broken edges of the corresponding strata on the west. Most of the ridges in the district have thrust faults of this character along their eastern bases.

Mineral resources.—These consist of coal, iron ore, mineral paint, manganese ore, limestone, building stone and brick and tile clay. The productive coal-bearing formations, the Lookout and Walden sandstones, occupy the upper portions of Pigeon, Lookout and Sand mountains, having an area in in this district of 116 square miles. The Lookout generally contains one, and in some places two or three, workable coal seams, but they are variable in position, extent and thickness. The Walden sandstone forms a considerable area on Lookout mountain, and contains at least one valuable seam of coal, which is extensively worked at the Durham mines. Two varieties of iron ore are found in workable quantities. The first is the red fossil or 'Clinton' ore, which occurs as a regularly stratified bed in the Rockwood formation, and is worked at various places along the base of Lookout mountain. The second variety is limonite, which occurs as a pocket deposit at the base of several of the ridges along the eastern border of the district. Associated with the latter, particularly along the faults, are deposits of manganese, generally as nodules scattered through the surface soil.

FOLIO 4, KINGSTON, TENNESSEE, 1894.

THIS folio consists of three and one-half pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1 : 125,000), a sheet of areal geology, one of economic geology, one of structure sections and one giving columnar sections.

Geography.—The map is bounded by the parallells 35° 30′ and 36° and the meridians 34° 30′ and 35°. The district represented lies wholly within the State of Tennessee, and includes portions of Cumberland, Morgan, Roane, Rhea, Loudon, Meigs and McMinn counties. Its area is approximately 1,000 square miles, and it forms a part of the Appalachian province, being about equally divided between the valley and plateau divisions of the province. The northwestern half of the district is a portion of the Cumberland Plateau. The surface of this half, except in the Crab Orchard mountains, is comparatively level and has an altitude of between 1,800 and 1,900 feet. Its streams flow in shallow channels until near the edge of the plateau, when they plunge into rocky gorges which form deep notches in the escarpment. The Crab Orchard mountains are formed by the uneroded portions of an anticline, the hard beds rising in the form of a low arch. Toward the southwest the hard beds were lifted higher and have been removed, exposing the easily erodible limestone beneath, and in this the Sequatchie Valley has been excavated. The southeastern half of the district lies within the great Appalachian Valley, here occupied by the Tennessee river, which flows at an altitude of about 700 feet, and above which rounded hills and ridges rise from 300 to 500 feet higher. The valley ridges have a uniform northeast-southwest trend parallel with the Cumberland escarpment, their location depending on outcrop of narrow belts of hard rocks.

Geology.—West of the Cumberland escarpment the geologic structure is very simple. The strata remain nearly horizontal, as they were originally deposited, except in the Crab Orchard mountains, where they bend upward, forming a low arch. East of the escarpment the strata have suffered intense compression, which has forced them into a great number of narrow folds whose axes extend northeast and southwest. The strata dip more steeply on one side of the arch than on the other; and, as a further effect of compression, the beds on the steeper (generally the northwestern) side have been fractured and the rocks on one side thrust upward and across the broken edges of those on the other. In this manner the folds first formed have in most cases been obliterated, and there remain narrow strips of strata separated by faults, and all dipping to the southeast.

The rocks appearing at the surface are entirely sedimentary—limestones, shales, sandstones and conglomerates—and include representatives of all the Paleozoic groups. The Cambrian formations consist of the Apison shale, Rome sandstone and Conasauga shale, a series which is calcareous at top and bottom and siliceous in the middle. The Conasauga passes upward through blue shaly limestone into the Knox dolomite, a formation about 4,000 feet in thickness, composed of siliceous or cherty magnesian limestone. Probably the lower portion is of Cambrian age, while the upper is undoubtedly Silurian. Above the dolomite is the Chickamauga limestone, whose upper portion toward the eastern side of the district changes from blue flaggy limestone to calcareous shale, and is called the Athens shale. The next formation is the Rockwood, which also changes toward the east from calcareous shale to hard, brown sandstone. These changes in the character of the rocks indicate that, while they were forming, the land from which their materials were derived lay to the southeast. The Devonian is represented in this region by a single stratum of carbonaceous shale, the Chattanooga black shale, which rests, probably with a slight unconformity, on the Rockwood. Above the Chattanooga are the Fort Payne chert and Bangor limestone of the lower Carboniferous, and the Lookout and Walden sandstones of the Coal Measures.

Mineral resources.—These consist of coal, iron ore, limestone, building stone and clay. The coal-bearing formations, the Walden and Lookout, form the surface of the greater part of the district northwest of the Cumberland escarpment, making a probably productive area of 370 square miles. The Lookout always contains one, and sometimes as many as four, beds, all of which are locally though not generally workable. The upper bed, immediately below the conglomerate, is the most constant. The greater part of the workable coal is contained in the Walden, the lower bed probably corresponding to the Sewanee seam farther west. This occurs in a belt 6 or 8 miles in width, along the eastern edge of the plateau. The only iron ore sufficiently adundant to be commercially important is the red fossil ore, which occurs as a regularly stratified bed in the Rockwood formation. The numerous folds east of the escarpment bring the Rockwood to the surface in long, narrow bands, along which the ore has been worked at many points. It varies in thickness from 3 to 7 feet, and, although at some places it passes into a sandy shale, it is generally a high-grade ore.

FOLIO 6, CHATTANOOGA, TENN., 1894.

This folio consists of 3 pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1 : 125,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

Geography.—The map is bounded by the parallels 35° and 35° 30′ and the meridians 85° and 85° 30′. The district is wholly within the State of Tennessee, embracing portions of Bledsoe, Rhea, Sequatchie, Marion, Hamilton and James counties. It lies partly in the great Appalachian Valley and partly in the plateau division of the Appalachian province. Its surface is marked by two distinct types of topography, the plateau and the valley. The former prevails in the western half of the district, which is occupied by portions of the Cumberland Plateau and Walden Ridge, the two plateaus being separated by Sequatchie Valley. The Cumberland Plateau has an altitude of about 2,100 feet, with a level or rolling surface. Walden Ridge has an altitude of 2,200 feet along its western edge, and slopes gradually eastward down to 1,700 feet. Both plateaus are bounded by abrupt escarpments from 900 to 1,400 feet in height, the upper portions being generally formed by a series of cliffs. The two plateaus are separated by Sequatchie Valley, which is about 4 miles in width. Its western side, the escarpment of Cumberland Plateau, is notched by numerous deep rocky gorges, cut backward into the plateau by streams flowing from its surface; while the eastern side, the Walden escarpment, forms an unbroken wall. The eastern half of the district is occupied by the Tennessee Valley, the river itself having an altitude of between 600 and 700 feet, while rounded hills and irregular ridges rise several hundred feet higher. Leaving the broad valley, which continues southward into Alabama, the Tennessee River turns abruptly westward at Chattanooga and enters a narrow gorge through Walden Ridge. This part of its channel is very young in comparison with the valley toward the north, and there is evidence that the river has occupied its present course but a short time, having formerly flowed southward directly to the Gulf.

Geology.—The rocks appearing at the surface within the limits of the map are entirely of sedimentary origin, and include representatives of all the Paleozoic groups. The Cambrian formations include the Apison shale, Rome sandstone and Conasauga shale, a series which is calcareous at top and bottom and siliceous in the middle. The Conasauga passes upward through blue limestone into the Knox dolomite—a great thickness of siliceous magnesian limestone, the lower portion of which is probably Cambrian. Above the dolomite are Chickamauga limestone and Rockwood shale, the latter becoming brown sandstone in White Ash Mountain. The whole of the deposition which took place in this region during the Devonian is apparently represented by a stratum of shale from 10 to 25 feet in thickness—the Chattanooga black shale, which probably rests unconformably upon the Rockwood. Above the Chattanooga are the Fort Payne chert and Bangor limestone, forming the lower Carboniferous, and the Lookout and Walden sandstones, forming the Coal Measures. Nearly all the formations exhibit an increase in thickness and in proportion of sand and mud toward the east, showing that the land from which their materials were derived lay to the east and southeast.

The geologic structure is simple in the region occupied by the plateaus, and complicated in the valleys. In the Cumberland Plateau the strata are almost perfectly horizontal, while in Walden Ridge they have a slight dip from the edges toward the center. Sequatchie Valley is located upon the westernmost of the sharp anticlines which characterize the central division of the Appalachian province. In the eastern part of the district the strata have suffered compression, which had forced the originally horizontal strata into a series of long, narrow folds whose axes extend in a northeast-southwest direction. In addition to the folding, and as a further effect of the compression which produced it, the strata have been fractured along many lines parallel with the folds, and the rocks upon one side—generally the eastern—have been thrust upward and across the broken edges of those on the other side. A fault of this character passes along the western side of the Sequatchie Valley, and several formations which would normally occur there are entirely concealed.

Mineral resources.—These consist of coal, iron ore, limestone, building stone, and brick and tile clay. The productive coal-bearing formations, the Lookout and Walden sandstones, occupy the surface of the plateaus. They have an area within the district of about 400 square miles, and contain from one to three beds of workable coal. The beds in the Lookout are generally variable in position, extent and thickness; those in the Walden are constant over large areas, and are worked on a considerable scale at various points along the eastern side of Walden Ridge. About 200 square miles of area of these upper coals occur within the district, on the Cumberland Plateau and the eastern half of Walden Ridge. The most important iron ore in the district is the red fossil or Clinton ore, which occurs as a regularly stratified bed in the Rockwood shale. The bed is from 3 to 5 feet thick in Sequatchie Valley, but considerably thinner in the vicinity of Chattanooga and eastward.

FOLIO 8, SEWANEE, TENNESSEE, 1894.

This folio consists of nearly four pages of text, signed by Charles Willard Hayes, geologist; a topographic sheet (scale 1: 125,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

Geography.—The map is bounded by the parallels 35° and 35° 30′ and the meridians 85° 30′ and 86°, and the territory it represents is wholly within Tennessee, embracing portions of Grundie, Sequatchie, Marion, Franklin and Coffee counties. The district lies almost wholly within the western or plateau division of the Appalachian province. Crossing its southeastern corner is the Sequatchie Valley, located upon the westernmost of the sharp folds which characterize the central or valley division of the province. The larger part of the district is occupied by the Cumberland Plateau, which has a gradual ascent toward the north, rising from an altitude of between 1,700 and 1,800 feet on the south to 1,900 or 2,000 feet on the north. The plateau is limited by a steep escarpment from 1,100 to 1,500 feet in height on the east and about 1,000 feet in height on the west. Many streams have cut their channels backward into the plateau, forming deep, narrow coves, so that the escarpment forms an extremely irregular line. Small portions of Walden Ridge and Sand Mountain appear in the extreme southeastern corner of the district, these being plateaus similar to the Cumberland Plateau farther west. A small portion of the Sequatchie Valley occupies the southeastern part of the district, with an altitude of about 600 or 700 feet, while its northwestern portion is within the 'highland rim,' a broad terrace surrounding the lowlands of middle Tennessee and separating it on the east from the Cumberland Plateau.

Geology.—The rocks appearing at the surface are of sedimentary origin, and include representatives of all the geologic periods from Silurian to Carboniferous. The Silurian formations, consisting of the Knox dolomite, Chickamauga limestone and Rockwood shale, occur only as narrow belts in the Sequatchie Valley. The same is true of the Devonian, which is represented by a single thin formation, the Chattanooga black shale. The Carboniferous formations occupy by far the larger part of the district, the Fort Payne chert and Bangor limestone forming the lower portions of the plateau escarpments and the highland rim, while the Lookout and Walden sandstones, belonging to the Coal Measures, form the summits of the plateaus.

The geologic structure of the region is in general extremely simple. The plateaus and the highland rim to the westward are underlain by nearly horizontal strata, while Sequatchie Valley is upon a sharp, narrow fold, the beds dipping downward on either side beneath the adjoining plateaus. If the rocks which have been eroded from the top of this arch were restored, there would be a ridge several thousand feet in height in place of the present valley. In addition to the folding which the strata have suffered along this line, they have been fractured, and the beds on the east have been thrust upward and across the edges of corresponding beds on the west of the fracture, so that along the western side of the valley the formations do not appear at the surface in their normal sequence.

Mineral resources.—These consist of coal, iron ore, limestone, building and road stone and clays. The Coal Measures occupy an area within the district of about 500 square miles. Not all of this area, however, contains coal beds of workable thickness, while some portions contain two or three workable beds. The lower beds, occurring in the Lookout sandstone, are variable in horizontal position, thickness and extent, so that they can not profitably be worked on a large scale; but they have been opened at many points, and supply an excellent fuel for local use. The Sewanee seam, which is found in the Walden sandstone, from 50 to 70 feet above its base, is the most important seam in the district. It has an average thickness of 4 to 5 feet over at least 80 square miles in the higher portions of the plateau, and is extensively mined for coking at Tracy and Whitwell. The iron ore of chief importance is the red fossil or 'Clinton' ore, which occurs as a regularly stratified bed in the Rockwood shale. At Inman, in the Sequatchie Valley, it attains a thickness of 5.5 feet and is extensively mined.

FOLIO 18, SMARTSVILLE, CALIFORNIA, 1895.

This folio consists of 4 pages of text, signed by Waldemar Lindgren and H. W. Turner, geologists, and G. F. Becker, geologist in charge; a topographic sheet (scale 1:125,000), a sheet of areal geology, one of economic geology and one of structure sections.

Topography.—The district of country represented lies between the meridians 121° and 121° 30′ and the parallels 39° and 39° 30′, and embraces about 925 square miles, comprising a part of the foothill region of the Sierra Nevada. The elevation ranges from 50 feet above sea-level in the northwestern corner to over 4,000 feet in the northeastern corner. The topography is characterized by a number of parallel ridges, running in a north-northwest direction. The northeastern part has more the character of an irregular and undulating table-land. Through the ridges and the plateaus the watercourses have cut deep and narrow canyons. The Yuba River with its branches drains the larger part of the district. Noncut Creek on the north and Bear River on the south are the only other streams of importance.

Geology.—Sedimentary formations occupy comparatively few areas in the district, all of which have been tentatively referred to the Calaveras formation, no fossils having been found in them. They consist of slates and quartzitic sandstones, usually with northerly strike and steep easterly dip. Diabase and porphyrite occupy large areas in the central and southern parts, as well as intrusive masses of granodiorite and gabbrodiorite. Amphibolites, resulting from the dynamo-metamorphism of diabase, gabbro and diorite, also occur in several places. The rocks of the district are principally massive, in contrast to those of the districts adjoining on the south and east. However, two lines traverse it along which extensive metamorphism has taken place and schistose rocks have been developed. The superjacent rocks, resting unconformably on the older series, consist of Neocene river gravels, together with beds of andesitic and rhyolitic tuffs. Comparatively small areas of these remain, the larger part having been carried away by erosion. Pleistocene shore gravels and alluvium occupy the southwestern corner. The Ione formation is not well exposed in this district, being in part covered by Pleistocene deposits, in part removed by erosion.

Economic Geology.—Important and rich Neocene gravel deposits in this district have been worked at Camptonville, Nevada City, North San Juan, Badger Hill, French Corral and Smartsville. Gold-quartz veins occur scattered throughout the area, but by far most of them are found in the immediate vicinity of Nevada City and Grass Valley. These districts are among the most important of the gold-mining regions in California. Many of the rocks of the district are adapted for building purposes. The only one in extensive use is the granodiorite, near Nevada City. The often deep-red soils in the foothill region are of residuary origin. Extensive areas of alluvial and sedimentary soils are found only in the southwestern corner.

INTERNATIONAL CLOUD OBSERVATIONS.

IN a series of papers on the storm tracks and allied phenomena, prepared under the direction of the Chief of the Weather Bureau, much has been written about the cyclonic circulation at the surface of the ground, but the subject would be very incomplete without alluding to the efforts that are being made to determine the circulations of the upper atmosphere all over the globe. Theoretical solutions, to some extent confirmed by observations, have been given, and yet the true connection between the general and the cyclonic circulation has not been properly cleared up and tested by experience. So far as the general movements are concerned, the components are somewhat as follows in the northern hemisphere, those south of the equator being counterparts. Along the meridian from Lat. 24° to the equator the component is south, to the pole it is north; in middle latitude, where the extra tropical cyclones prevail, there is a northern component in the middle cloud strata, and two southern components, one near the ground and one in the cirrus strata. Along the parallels of latitude there are two systems of components; from 0° to 35° latitude, a westerly component at the surface, and an easterly in the higher layers; from 35° to 90° latitude two easterly components, making a maximum and rapid eastward drift in the neighborhood of 54°. In the vertical, from 0° to 20° and from 70° to 90° latitude, there is an upward component; from 20° to 70° latitude, a downward component. The cyclonic and the anti-cyclonic motions to some extent spring out of these, but the really active part of them is confined to the strata within two miles of the ground, and yet the precise course of the stream lines is not comprehended throughout their extent.

Much light has been thrown upon the obscure features of these problems by observation at high altitudes, and especially by measurements of cloud heights and velocities, but still much remains to be done to reach satisfactory conclusions. It is thought that some account of these observations to be undertaken shortly, and a reference to the important literature regarding them, may be of interest to those who have these subjects at heart, especially those who are coöperating in the work of the U. S. Weather Bureau.

The attention of meteorologists, in the early developments of the subject were, naturally almost exclusively confined to studies on the data furnished by the lowest stratum of the atmosphere. The circulation and physical conditions of the air in the higher strata were investigated to some extent by means of the theoretical considerations and the general movements of clouds. It has, however, become apparent that a scientific knowledge of the action of the currents in cyclones and anti-cyclones can be obtained only by a determined attack upon the physics of the upper levels of the atmosphere. Progress in meteorology, working along the original lines at the surface of the ground, has for a number of years been disappointing, and it is well known that in the art of forecasting almost exactly the same methods that were perfected twenty years ago are still employed. There seems to be little hope of improving this state of affairs, unless a radically new way of dealing with the data can be devised, which will efficiently supplement the system now in use.

The Chief of the Weather Bureau has expressed the opinion that there are two or three lines of investigation promising the wished-for results. One is the practical development of the knowledge already gained regarding the polar magnetic radiation from the sun. The serious difficulty in the way of doing this has been the expensive and complicated nature of first-class magnetic observatories, which must necessarily limit the number in the United States. What was wanted was a simple, inexpensive and yet reliable instrument, that could be utilized as readily as a barometer, thermometer or a watch. It seems now, after a couple years of trial, that such an apparatus is in hand, and a record of its performance will be published, with a description of it, beginning in the January number of the *Weather Review* for 1896.

Another process for getting at the action of the upper air is the transportation of barometers, thermometers and other apparatus into the higher levels. This can evidently be done by mountain stations, balloons and kites, and experiments are being conducted by the Weather Bureau to carry out this purpose as far as practicable.

A third line of investigation is the study of the clouds in all their aspects; the conditions under which the several forms are developed; the heights of the several levels, the variations of the same in the diurnal and annual periods, and particularly in connection with the cyclonic circulation of the lower strata; the direction and velocity of movement in the general circulation of the currents of the atmosphere as well as around the barometric maxima and minima. The fact that clouds are present almost every day in a series of forms which pass from one to the other by delicate gradations, each of which must indicate specific physical properties, shows that this is a very rich field of research, which has been only imperfectly cultivated. Many interesting conclusions have been developed by observers of such phenomena in the past fifteen years, but only during the past five years has the conviction become general that this is one of the most important studies for the practical meteorologist.

With the view of reducing the details to uniformity of method, and to secure coöperation among the observers in different countries, an organization has been completed which will go into effect this spring. A brief history of the movement is as follows: The measurement of cloud heights is an old problem and many devices have been invented for the solution of the practical difficulties, of which a full account may be found in the Report of the Chief Signal Officer, Part 2, 1887, by Prof. Cleveland Abbe. More or less systematic observations, extending over considerable periods of time, have been made at Berlin, Upsala, Storlien, Kew and Blue Hill, (Mass.), by methods depending upon triangulation. Besides the simple trigonometric formulæ, another system for computing the shortest distance between the two sight lines, devised by Ekholm and Hagström, Upsala, also a process for reducing the points on a photograph plate exposed in a photogrammeter by Åkerblom, Upsala, have been successfully used and are recommended as the best known.

The following are the leading papers on cloud observations:

1. Mesures des hauteurs et des mouvements des nuages, par N. Ekolm et K. L. Hagström, Upsala, 1884.

2. Des Principales méthodes employeés pour observer et mesurer les nuages, par Hildebrandsson et Hagström, Upsala, 1893.

3. De l'emploi des photogrammètres pour mesurer la hauteur des nuages, par Akerblom, Upsala, 1894.

4. Observations made at the Blue Hill Meteorological Observatory, Annals Harvard College, Vol. XXX., Part III., by H. H. Clayton and P. S. Fergusson, 1892.

At the International conference, Munich, 1891, a committee was appointed to consider the question of concerted observations on the direction of motion and the height of clouds. This committee recommended that observations on the direction of motion and the height of clouds should be commenced at certain stations distributed over the globe, and continued for one year; that short instructions be prepared for these observations; that the scheme of cloud classification put forth by M. M. Hildebrandsson and Abercromby be adopted, and a cloud atlas illustrative thereof be published.

As the result of these propositions, the coöperative international cloud observations will begin May 1, 1896, and continue one year. As far as known, the theodolite method will be employed at Washington, D. C., Blue Hill, Mass., and Christiania; the photogrammeter method at Upsala, Paris, Potsdam, Petersburg, Nijni Novgorod, Manila, Batavia, Melbourne and probably Kew, Calcutta and Sydney. The difficulty in cloud observations is to have two observers, separated by a base line nearly one mile long, set their sight lines on exactly the same point of a rapidly moving and dissolving cloud. The advantages of the theodolites is that the instruments are cheaper, many more observations can be taken with the same labor and the calculations are the briefest possible by any method. The observations that must be rejected at the outset can be determined by a small plotting machine, being a model of the real base line and instruments, such as invented by H. H. Clayton, at Blue Hill. Photographs, on the other hand, possess the advantages of giving definitely the point on the cloud, but the difficulty of securing photographs of all kinds of clouds in all weather is very great, and the cost of the work much more for the same number of individual observations. The international classification of cloud forms has been issued, and it will be adopted by the Weather Bureau and go into operation July 1, 1896, throughout the service. Suitable instructions and illustrative forms have been prepared for the observers, with which they are to become familiar before the date mentioned. The atlas of cloud forms issued by the Committee is now ready for distribution, and may be purchased of M. Teisserenc de Bort, Bureau Central Meteorologique, 176, rue de l'Universite, Paris, France.

Besides the observations with theodolites and photogrammeters for the actual heights and velocity of motion of clouds at the primary stations, a number of secondary stations for the relative motions, and the other available data, will be established in each country. In the United States there will probably be ten such stations under the immediate control of the Weather Bureau, equipped with nephoscopes for the observations. It is very desirable that the network of the stations be made as complete as possible in all parts of the country, and it is hoped that this opportunity for coöperation may be embraced by other persons willing to do some valuable scientific work. The colleges might profitably instruct their students in such observations at a very moderate expense. A first-class nephoscope can be made for twenty dollars, and serviceable ones at lower rates. The observations would require half an hour's work three times a day, between 8–9 a. m., 1–2 p. m., 5–6 p. m. The Weather Bureau will furnish suitable instructions to observers, and will aid them as far as possible in explaining the very simple computations that would be needed to prepare the observations for final discussion.

There are many forms of nephoscopes in use, but the one devised by Prof. Marvin, of the Weather Bureau, seems to be especially well adapted to the requirements. A description of it will be found in the January number of the *Weather Review*. It may be said in this place that its best feature is the device for keeping the sighting knob exactly twelve centimeters above the mirror in every possible position, so that the unit of height becomes 1000 meters, and the velocity in meters per second at that height is just one third the number of millimeters passed over by the image in 25 seconds. This makes the computations very easy, and when the height of the cloud level is known from the theodolite work, the actual velocity is obtained by simply identifying the cloud observed from its form as belonging to such a level. The mean of a large number of observations gives a true velocity. The base line at Washington is about 1360 meters long, one end on the Weather Bureau building, and the other on the War, State and Navy building. The ratios of velocity by the theodolites and nephoscopes at this station, in the different cloud levels, gives the means of using other nephoscope observations, provided the naming of the cloud forms is carefully done.

The ultimate problem is to obtain the coördinate velocities of the several components in the general circulation, and the relation that these have to the cyclonic circulations which depend upon them. The importance of these solutions to the art of forecasting, and the fact that voluntary observations made in widely separated parts of the United States are needed as contributions to the network, together with the simplicity that pertains to nephoscope work, induces the hope that some interested in the physics of the air may take up the task of coöperation.

Frank H. Bigelow.

Washington, D. C.

NOTES ON NATIVE SULPHUR IN TEXAS.

ABOUT 40 miles northwest of Pecos City, and 20 west of Guadalupe station on the Pecos Valley Railroad, are some deposits of sulphur, a short account of which may be of interest to the readers of SCIENCE.

These deposits occur in the 'Toyah Basin' (or its extension), referred to by Prof. R. T. Hill in his report on the Artesian waters of Texas. This basin is one of a series of lacustrine formations occupying valleys eroded in the plains or enclosed by mountain blocks, the underlying and enclosing formations being the Red Beds and the lower strata of the Comanche series of the Texas geologists.

To the northwestward of Guadalupe station, and distant some fifty or sixty miles, the Guadalupe mountains (of Paleozoic rocks) end with a perpendicular escarpment of at least a thousand feet in height, forming a conspicuous as well as a most beautiful feature of the landscape. Twenty-five or thirty miles west of the station a range of hills two to five hundred feet in height, with increasing altitude towards the west, and composed of the yellowish calcareous sandy rocks, probably of the Comanche horizon, makes the first interruption to the monotony of the plain in this direction. From the station out to these mountains and hills, and to the southwestward, beyond the limits of vision, the country is in general terms a level plain; in detail, a succession of low ridges and shallow ravines or 'draws,' the result of the erosion of the original plain. The region is practically destitute of trees, but there is on the elevations a scanty growth of yucca, dwarf mesquite, cactus and similar desert plants, to which in the lower and moister places there is added a dense growth of grasses, and in places a few stunted cedars.

The shallower ravines expose only the materials of the basin formation, coarse sand loosely cemented by lime; silt, usually pinkish or light chocolate brown in color, water-worn siliceous pebbles; and 'tierra blanca,' a white chalky calcareous material possessing some hydraulic properties (Hill). In the deeper ravines erosion has laid bare the underlying formations, which are, according to locality, the red or dark purple clayey materials of the Red Beds or the sandy yellowish limestones of the Comanche. In these deeper 'draws' are a few springs of gypseous water which flow off in rather bold streams, to be speedily absorbed by the porous soils. Two of these, the Screw Bean and the Maverick springs, are between the station and the sulphur deposits. Besides these there are several springs whose waters are strongly impregnated with sulphur, and where the pools of water stand for some time they become briny, leaving, upon evaporation, a thick crust of salt. The level country between the limestone hills above mentioned possesses somewhat similar characters, and in the plain enclosed by these hills there is a fine spring of slightly gypseous water some five miles to the westward of the farthest of the sulphur localities. This is at the Tiernan ranch where the water has been used to some extent in irrigation around the ranch.

At the three places visited by me the sulphur was found below bare, apparently wind-swept, spots, its presence being usually indicated either by clusters of gypsum crystals in the soil, or by an outcrop of the sulphur itself, sometimes tolerably pure, sometimes cementing the surface pebbles into a conglomerate. When further exposed by pits, the sulphur is seen to occur in nests and irregular veins filling small fissures or crevices in the soil, the sides of these fissures being often lined with well-developed sulphur crystals up to one-fourth of an inch in size. The whole of the earth, to the depth of ten feet or more at the three localities visited, appeared to be impregnated with sulphur, sometimes almost imperceptible to the eye, but oftener in minute crystals concentrated along irregular lines. Where thus generally disseminated through the brown or chocolate-colored earth, the sulphur makes some 10 or 15 per cent. of the whole weight, but where concentrated along the lines above mentioned the percentage of sulphur goes up to 40 or 50 and even higher, for not infrequent is the occurrence of sulphur in the massive form, very light yellow in color, opaque, and of earthy aspect, resembling a yellowish meerschaum, but of exceptional purity, several analyses of average samples showing 97 per cent. sulphur. The average content of sulphur in the material penetrated by the several pits which were examined by me could not be far short of 50 per cent.

In the immediate vicinity of one of the occurrences the surface soil is highly charged with gypsum, which appears in small crystals and in large groups of crystals imbedded in the white calcareous sandy material rendered strongly acid by the decomposition products of the sulphur. At one place the sulphur beds rest upon an impure limestone which has been so greatly corroded by these acids as to be very difficult of identification.

Upon exposure to the air the sulphur rapidly undergoes alteration, being in great part finally converted into sulphuric acid, but becoming first opaque and soapy. From this cause the heaps of nearly pure sulphur piled around the mouths of the prospecting pits, rapidly disintegrate and disappear. In many cases, however, this waste has been partly due to the mechanical action of floods which, by reason of the occasional heavy rainfalls, sweep down the generally dry 'draws,' carrying everything before them. The sides of the pits and the materials thrown out of them exhale a peculiar odor (sulphury), and are so strongly acid as to destroy quickly the clothing and other organic matters brought in contact therewith.

The sulphur beds do not appear to underlie uniformly the whole basin, for in the region indicated, within a radius of twenty miles, only three places are as yet known where they occur. The actual outcrop by natural or artificial exposure will here cover some four or five acres, but the probability is that the sulphur in each of the localities underlies a much larger area, for wherever penetrated by borings or pits the sulphur-impregnated earth has been encountered to a depth of at least ten feet, and a deposit of this thickness could hardly be conceived to thin down so rapidly as to limit the occurrence of the sulphur to the small area in which it has actually been exposed.

Nor, on the other hand, are the sulphur deposits of Texas confined to the particular region designated in these notes, for there are well authenticated reports of their occurrence both to the westward and to the northward, the former from cowboys, through whose representations attention was first directed to the beds above described, the latter upon the authority of Capt. John Pope, who had charge of one of the divisions of the survey of the railroad routes to the Pacific. Along the banks of Delaware creek he collected a sample of earth which contained 18.28% of sulphur, and he comments also upon the frequency of sulphur springs in the same region. Delaware creek rises among the Guadalupe mountains and flows into the Pecos river some fifty miles to the northward of Guadalupe station.

The materials filling the basins of the Trans-Pecos region have very generally been considered as of lacustrine origin, and of the truth of this supposition we have very good proof in the great number of fresh-water diatoms discovered in the sulphur-impregnated earth submitted by me to Mr. K. M. Cunningham, of Mobile, for microscopic examination. The basin formation is considered by Mr. Hill to be of Pleistocene age, but somewhat more recent than the Llano Estacado.

In regard to the origin of the Texas sulphur beds, the most significant of the associated materials are the beds of gypsum which a few miles to the northeast are of commercial importance because of their great thickness and purity; the springs of sulphur water which are abundant along all the deeper drainage ways; and the ancient lake deposits which practically make the country. These deposits contain much organic matter along with calcareous and siliceous sediments.

The sulphur deposits of Sicily have probably received more careful study than any others, and they are generally thought to be derived from springs charged with calcium sulphide or sulphuretted hydrogen and carbonate of lime, resulting from the decomposition of gypsum in presence of organic matter. The decomposition products of the sulphur, in turn, acting upon calcareous matters, yield gypsum, thus completing the cycle.

Without enquiring into the origin of the great gypsum deposits of this section, I think we must consider the sulphur as one of its products, though due more immediately to the oxidation of sulphuretted hydrogen.

If these deposits were more accessible there could be no question as to their commercial importance. They are twenty miles from railroad lines, and in a country destitute of fuel and with scanty supply of surface waters. On the other hand, there would be no difficulty in the way of constructing a railroad or tramroad, which could be built out to the sulphur beds almost without grading, and that a supply of water could be had by artesian borings is as good as certain, for further down the basin near Pecos City abundance of water is obtained from borings of 200 to 300 feet. The nearest source of fuel would probably be the Texas coal fields.

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CURRENT NOTES ON PHYSIOGRAPHY.

THE ADIRONDACK MOUNTAINS AND VALLEYS.

A FEW pages in the account of Essex county, N. Y., by Kemp (Rept. State Geol., N. Y., 1893, 438–441) describe the Adirondack ridges thereabouts as trending to the northeast, Lake Champlain rounding their ends in a series of bays. The longitudinal valleys are said to be chiefly due to faults, and the mountains are regarded as of the tilted-block type; the evidence of the faults being found in breccias and shear zones (as of Avalanche lake, Amer. Journ. Sci., Aug., 1892), and in the narrow 'passes' which are said to be evidently produced by fault scarps. Moreover, the ridges are commonly abrupt on one side and slope more gradually on the other, as in Knob mountain. A later report by the same author states that the relief of the region is not caused entirely by erosion, but that it is 'in a large part due to block faulting' (Bull. N. Y. State Museum, III., 1895, 328). It is further concluded that many of the valleys must have been outlined in pre-Cambrian times; for small areas of Potsdam sandstone occur in the depressions far within the mountains.

TOPOGRAPHIC FORMS PRODUCED BY FAULTING.

THE context of the above extracts seems to indicate that their author infers an ancient date for the faults mentioned, and a considerable amount of erosion subsequently in the excavation of the valleys; yet the hasty reader might gather the idea that the forms now visible were directly initiated by faulting of comparatively recent date. It is not decidedly stated whether the faults lately produced the existing relief, or whether the fault lines, as lines of weakness, have been eroded down into valleys, or whether the valleys have been lately (*i. e.*, in Tertiary time) eroded out of weak masses of rock that were long ago brought by faulting next to hard masses, or whether the valleys have lately been re-excavated in the Paleozoic rock-filling of ancient fault-block valleys; nor is the date of the faults explicity stated. Here, as in many other cases, it is probably difficult to choose among these alternatives. Type examples of the various relations of form to faulting are, however, well known. Monoclinal ridges of strong relief, initiated by faulting and as yet hardly affected by erosion, are found in the tilted lava blocks of southern Oregon, described by Russell. The ranges of the Great basin are thought to be older fault blocks, more or less altered by erosion; but it is difficult to determine from the published descriptions by various observers all the elements of the problem; namely, the form that the region had before faulting, the form given by faulting (distinction being made between the uplifted back slope and the broken face of the faulted and tilted blocks), and finally the forms produced by erosion after faulting. Our Appalachian region offers plentiful examples of the complete extinction of the unequal relief initiated by ancient faults, as well as many other examples of notches and valleys whose erosion, in a new cycle after peneplanation, has been guided by fault lines or by the weaker parts of ancient faulted structures.

The well proved geological occurrence of a fault has been often taken as a sufficient explanation of form, without the aid of erosion. For example, Kjerulf regarded faults as the cause of the valleys and fiords of Norway; but it is probable that the faults there are for the most part of ancient date, while the valleys can hardly be older than Tertiary times. The zigzag escarpments of the crystalline uplands east of Lake Vettern, in Sweden, imitate to perfection the forms that might be produced by recent faulting (see sheets 55, 56 of the Swedish topographical survey). Faults are numerous in the region, but it is probable that the inequalities here due to faulting were long ago worn out in the general denudation that produced the upland (once a lowland peneplain) of Scandinavia; and that the escarpments now visible were produced, after a general uplift of the region not longer ago than somewhere in Tertiary time, by the erosion of the weaker Paleozoic beds that had much earlier been faulted down next to the crystallines. How all this may be in the Adirondack region will perhaps be more fully determined by further observation.

THE BALTIC SEA.

Prof. Rudolph Credner, of the University of Greifswald, whose monograph on Rügen (Forschungen z. deut. Landeskunde, vii., 1893, 377–494) gives an interesting account of the interglacial deformation of that island, now extends his studies to the origin of the depression in which the Baltic lies. Placed between the oldland of Scandinavia and the younger deposits of the North German plain, the minor depressions contained within the general basin are ascribed to local faulting, more or less modified by later denudation, especially by glacial action. The observed faults on either side of the Baltic are taken to indicate that other faults occur beneath the waters of the sea. The outlines of the present shore result from broad oscillations of level, whereby the area of the sea has been significantly altered in comparatively recent times (Hettner's Geogr. Zeitschr., i., 1895, 537–556).

The analogy, pointed out by Suess and others, between the Baltic and our Great Lakes appears to deserve greater emphasis than is given to it by Credner. The Baltic and the lakes lie, as a whole, between an oldland and a series of less ancient strata, dipping away from it. The Gulf of Bothnia and Lake Superior are both within the limits of the oldland; the other basins are along the margin. In our Great Lakes, local faulting has not been noticed. As for the Swedish faults, most of them are too ancient to have any effect on existing topography, except as guides for modern erosive forces. Warping of a longitudinal depression, originally produced by ordinary denudation and modified by glacial erosion and deposition, appears to deserve greater importance than Credner allows it.

'SHUT-IN' VALLEYS.

THE St. François mountains of southeastern Missouri consist of very ancient rock masses that have been more or less completely buried in Paleozoic strata, and that are now partly resurrected by the stripping of their cover. An expected feature of such mountains is the occasional occurrence of narrow superposed valleys, either still occupied or now deserted by their streams. A typical example of the latter kind is found in the notch that holds Devil's lake in the Baraboo ridge of Wisconsin, explained by the Geological Survey of that State as the former superposed course of the Wisconsin river. A report by Keyes on the Mine la Motte sheet of the Missouri geological atlas now announces the occurrence of several narrow valleys of this class still occupied as water courses, and so unlike the broader valleys up and down stream that they are locally known as 'shut-ins.' A good example is found two miles west of Fredericktown, where the Little François river passes through a narrow gorge in the porphyry mass of Buckner and Devon mountains between open limestone valleys up and down stream. Discordance of drainage with their surroundings, as well as of structure, form and products, thus seems to characterize resurrected ancient mountains. Monadnocks, on the other hand, may be said never to be traversed by streams. W. M. DAVIS.

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CURRENT NOTES IN METEOROLOGY.

UNDER the heading Current Notes in Meteorology it is intended to publish, from week to week, or as opportunity may offer, short notes on recent publications of general interest and of importance in meteorology and climatology. Meteorology, although one of the newest of the sciences, is growing in importance every day, and its literature is rapidly increasing. To-day every scientific man needs some knowledge of what this literature is. Unfortunately, since the suspension of the *American Meteorological Journal*, in April of this year, there exists no representative independent meteorological publication in the United States. There is, therefore, at present no American journal to which one may turn for information regarding recent meteorological literature. It is the main purpose of these notes to supply this need, and to give the titles, together with a few words as to the contents, of such publications in meteorology and climatology as seem to warrant notice in a general scientific journal such as this is. Mention will also be made of meteorological phenomena of interest, accounts of which appear from time to time in records of travel, the *Monthly Weather Review* of our Weather Bureau, the bulletins of the various State Climate and Crop Services, etc. In this way it is hoped to furnish, in this column, a source of information on general meteorological and climatological matters that is at present lacking in the United States.

MAY 1st was the date set for the beginning of the International Cloud Year, in accordance with a resolution adopted by the

International Meteorological Committee at its meeting in Upsala in August, 1894. Nine countries have promised to coöperate in the work, which includes determinations of the altitudes, directions and relative velocities of clouds. These countries are as follows: Batavia, France, Norway, Portugal, Prussia, Roumania, Russia, Sweden and the United States. One or two stations in each country are to furnish observations of altitudes, determined by means of theodolites or photogrammeters, while at certain auxiliary stations records of direction and relative velocity will be kept. In the United States, the chief office of the Weather Bureau, in Washington, and the Blue Hill Observatory, in Readville, Mass., will determine altitudes, while the observations of direction and velocity will be made at Washington, New York, Buffalo and Detroit. The records collected during the year will certainly throw much light on certain much-debated questions of cloud movements and of cyclonic action.

Artificial tornado clouds have recently been produced by Dines in England (Quart. Jorun. Roy. Met. Soc., Jan., 1896, 71–73). The apparatus used was a simple one. Two glass screens, 2 ft. high, each consisting of three leaves, were set upon a table so as to leave a hexagonal space in the middle. On top of the glass plates a wooden panel of the requisite size was placed, with a round hole 7 in. in diameter in the center. In the hole there was a ventilating fan, driven by hand, and in the center of the table, between the screens, a shallow vessel containing water was placed, heated by a spirit lamp, in order that sufficient vapor might be obtained to form the funnel cloud. When the fan is turned on in this apparatus an upward current of air is produced at the center, and a cloud is formed. This cloud has a distinct rotary motion around the center, increasing in velocity as the center is approached. There is further a strong updraft, a great decrease of pressure in the center, and the cloud column is distinctly hollow, in all these respects closely simulating the actual tornado funnel cloud. The conditions of the experiment are, however, so unlike those existing in nature during the occurrence of tornadoes that, although interesting, the results cannot be considered as very important.

Attention has lately been again directed to the matter of Arctic Exploration by reasons of the rumors as to Nansen's voyage, and the frequent allusions, in scientific papers, to Andrée's balloon expedition, which is to start this summer. The recent publication of Gen. Greely's Handbook of Arctic Discoveries (Boston, Roberts Bros., 1896) is therefore very timely. Gen. Greely, as is generally known, led the United States expedition sent out in 1881 to take part in the system of international meteorological observations planned by the International Meteorological Conference and the International Polar Conference in 1879. Fifteen expeditions were sent out as a result of this plan, and they together made up the line of International Circumpolar Stations, whose work has been of such great importance in meteorology. Gen. Greely gives a general account of Arctic discoveries, and devotes one chapter to the International Circumpolar Stations.

A note on a rather unusual meteorological phenomenon appears in the February Bulletin of the New England Section of the Climate and Crop Service. On February 19th, on the campus of Trinity College, Hartford, Conn., a southerly wind, blowing over a thin covering of damp snow, caught up little pellets of this snow and, rolling them over and over, made them into muffs or 'rollers.' These 'rollers' increased in diameter as they were driven on by the wind, until some of them measured 8 inches in diameter and 8 inches in length. The cylinders had conical depressions at each end, these depressions nearly meeting at the center. Similar 'rollers' were observed in Connecticut on February 20, 1883, on which day some of them measured 12 x 18 inches, and their paths could be traced for 20 or 30 feet in the snow. R. DEC. WARD.

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CURRENT NOTES ON ANTHROPOLOGY.

ELEMENTARY PSYCHICAL CONCEPTS.

THE eminent anthropologist, whom his disciples love to call the 'Altmeister' of the science, Dr. Adolf Bastian, has added another to his numerous works by one recently published in Berlin (Weidmannsche Buchhandlung), entitled 'Ethnische Elementargedanken in der Lehre vom Menschen.' These elementary or rather elemental thoughts may be looked upon "as the germinal matter out of which proceeded the psychical growth of the ethnic organism in its various methods of mental or spiritual expression," as the author states in his preface.

The subjects treated are those opinions which primitive peoples had and have on the topics relating to the ultra- or supernatural world, and its relations to man; such as divinity, the under-world, guardian spirits, mysteries, names, prayer, sacrifice, prophecy, heaven, hell, fate, evil, good, the creation, miracles, femininity, vows, witches, immortality, and a host of similar notions, which the author treats with his usual astonishing, overflowing and overwhelming erudition, and with that complexity of style which simply appals a foreign reader. Anyone who wishes a 'hard lesson' in German should take up the author's introduction to his second part.

PATHOLOGY IN ETHNOLOGY.

ONE of the most enlightened German writers on ethnology, Dr. Thomas Achelis, makes the following remark in an article in *Globus*, No. 4, 1896: "Every form of degeneration, since it is a pathological process, does not belong primarily to subjects of ethnologic study." He would grant the first place only to subjects which reveal organic development, progressive evolution, and lift to higher phases of culture.

This seems a serious error. It is the duty of the ethnologist, as of every other scientist, to study things as they are, awarding to each an equal amount of attention. What appear to be degenerations are often necessary steps in life process. Important advances in physiology have frequently been gained by the study of pathology. Science is untrue to itself when it undertakes to make the defense of evolution its chief aim. It should seek exact truth, indifferent as to whether that makes for goodness or for badness, as we judge those norms. "What seems most against nature, is yet natural," said Goethe; and whatever is natural, whatever is real, in other words, should claim our consideration, independently of its imagined tendencies; and nowhere is this more essential than in ethnology.

THE ANTHROPOLOGIC STUDY OF PERSONALITY.

THE word *persona* originally meant the mask which actors wore on the scenic stage; and a cynic would say that personality often means the same to-day. Strictly, we may use it as a synonym of individual self-consciousness, or the knowledge of self as a subject. In previous ages it was studied exclusively by introverted mental observation, and this led to vague speculations on the "Ego," of small positive worth.

In the '*Revue Scientifique*,' January 25th, Prof. Pierre Janet, of the College de France, lays down the principles for the anthropologic study of this phenomenon of personality. In itself it is to be regarded as the synthesis of the conscious and unconscious mental experiences of the individual, and it is to be defined and investigated by these methods: 1. The examination of self as heretofore carried on. 2. The examination of allied phenomena in the healthy condition of other minds, bringing them into comparison with our own; and, 3. The examination of minds more or less diseased in the direction of their personality. He lays especial stress on the last mentioned, referring to cases where the sense of personality has been partly or wholly lost. The problems of unconscious cerebration, sublimital consciousness, and the like, must also receive due attention.

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SCIENTIFIC NOTES AND NEWS.

THE INTERNATIONAL CATALOGUE OF SCIENCE.

The International Conference to consider the preparation of a catalogue of scientific literature by international coöperation will be held at the rooms of the Royal Society, London, beginning on Tuesday, July 14th.

The committee of the Royal Society suggests provisionally that the author and subject catalogue shall be restricted in the first instance to branches of pure science, such as mathematics, astronomy, physics, chemistry, geology, zoölogy, botany, physiology and anthropology, to the exclusion of applied science, such as engineering, medicine and the like, but that all definite contributions to pure science shall be thoroughly indexed, whether occurring in books, memoirs, etc., treating of pure science or in those devoted to applied or practical science.

The committee also recommends that there shall be a first issue of authors' titles, subject-matter, etc., in the form of slips or cards, which shall be distributed as speedily and as frequently as possible to subscribers, and that a further issue in book form shall take place at such intervals as shall be determined on, parts corresponding to the several sciences, being, if found desirable, published separately.

It is recommended that a central bureau shall be established under the control of an international council having authority over any undertaking which may be allotted to particular countries, institutions or persons. The cost of the catalogue, in so far as it is not met by sales, should be provided for by means of a guarantee fund subscribed by governments, learned societies, institutions and individuals throughout the world, and it is estimated that the annual sum thus to be secured should be approximately $50,000.

The conference will have to take into consideration where the bureau shall be placed, how the international council shall be appointed and organized, what language or languages shall be used and what system of classification shall be adopted. It is suggested that the decimal system of Dewey may be so amended as to be worthy of adoption.

As already stated in this journal, the delegates to the conference from the United States are Dr. John S. Billings and Prof. Simon Newcomb.

EXHIBITION OF THE NEW YORK MICROSCOPICAL SOCIETY.

The Seventeenth Annual Exhibition of the New York Microscopical Society took place at the American Museum of Natural History on Tuesday evening, April 14th. The attendance steadily increasing from year to year has been a true indication of the value of this exhibition in what is usually spoken of as 'popularizing science.' The indiscriminate study of natural science often works more harm than good, especially if it be acquired through desultory and misdirected reading. Personal observation insures the safest and most lasting knowledge of Nature's acts and works. If this principle has been inculcated into the non-scientific portion of the audience, one purpose of the exhibition will have been accomplished. Persons more directly concerned and interested in scientific work also found enough to attract their attention.

The catalogue of seventy exhibits included many specimens of chemical crystals and minerals; various forms of pond life; the mouth parts of several insects, with specimens of their destructive borings in wood and other substances; drug plants and preparations of these; microscopical tests for the detection of quinine, morphine and various poisons; the methods of studying bacteria, with complete set of cultures, apparatus, etc.; photomicrographs and preparations illustrating the structure of steel, and many other objects of interest.

At nine o'clock Dr. Edward G. Love, the President of the Society, gave a brief lecture on the use of the microscope in the examination of the fibers of various textile fabrics, fully illustrated by lantern slides. The committee of arrangements consisted of Messrs. George W. Kosmak, George H. Blake and William B. Tuthill. It seems no more than right and proper to acknowledge at this point the obligations which this and other scientific societies of New York should feel towards the Museum authorities for the many courtesies and favors shown.

G. W. K.

BULLETINS OF THE DIVISION OF ENTOMOLOGY.

As previously announced in these columns, with the interruption of *Insect Life*, the periodical bulletin of the Division of Entomology, U. S. Department of Agriculture, the publication of two series of bulletins was begun, the first a technical series, embodying the results of the purely scientific work of the members of the force of the Division, the second a general series of economic bearing. Of the first series two numbers have been published, the first, A Revision of the Aphelininæ of North America, by L. O. Howard, and the second, The Grass and Grain Joint-worm Flies and their Allies; a Consideration of Some North American Phytophagic Eurytominæ, by the same writer. The last named publication has just appeared. It embodies descriptions of nineteen species of plant-feeding Eurytominæ, fourteen of which are new. All of the species make galls in the stems of graminaceous plants, with the exception of two which feed in the seeds of Vitis. Mr. Howard rehabilitates, on structural grounds, the colorational species of Isosoma, established by Fitch, and decides that the species which Fitch considered to be *Isosoma hordei* is entirely distinct from Harris' species, and that the latter corresponds with Fitch's *Isosoma fulvipes*.

The general series of bulletins so far issued includes No. 1, The Honey Bee; a Manual of Instruction in Apiculture, by Frank Benton; No. 2, Proceedings of the Seventh Annual Meeting of the Association of Economic Entomologists; and No. 3, The San José Scale: its Occurrences in the United States, with a full account of its Life History and the Remedies to be used against it, by L. O. Howard and C. L. Marlatt. The last-named is a pamphlet of 80 pages and includes a very full illustrated account of *Aspidiotus perniciosus*, particularly in regard to its eastern occurences; the life history of the species as determined by careful indoor experiments at Washington; and a complete bibliography.

GENERAL.

THE sub-committee of the New York Legislature has reported to the Assembly recommending that the State Geological Survey be placed entirely under the management and direction of Dr. James Hall.

THE Council of the Royal College of Surgeons, England, has awarded the Jackson prize to Dr. A. A. Kanthack for an essay on tetanus, and the Walker prize, for the best work on cancer, to Mr. H. J. Stiles.

THE United States civil service commission will hold an examination in Washington and other cities, commencing at 9 a. m. on May 15, to fill two vacancies in the position of scientific assistant in the fish commission, the salary of one position being $720 per annum and of the other $1,200 per annum.

WE learn from *Nature* that a memorial has been projected in Germany to the late Prof. Hermann Hellriegel, of Bernburg, who died in September last. It is proposed to erect a monument in the churchyard at Bernburg, where the remains of the distinguished investigator are interred. An appeal for contributions has been issued, and a small committee, consisting of the President and Secretary of the Bernburg Agricultural Society and Dr. Wilfarth, Hellreigel's colleague in his researches, has been formed to carry out the details.

SENATOR CANNON, of Utah, has introduced into the Senate a joint resolution proposing the construction at Washington of a map of the United States on a scale of one foot to the mile.

IT is stated that Sir Wollaston Franks, who has been an officer of the British Museum since 1851, will shortly retire from the head of the department of British and Mediæval Antiquities.

A CABLE despatch states that the Governor of Yakutsk reports officially that the inhabitants of Ust-Yansk have not heard anything about Dr. Nansen, the Arctic explorer, who was recently reported to be returning after having discovered the North Pole.

A VITASCOPE devised by Edison, and similar to the kinetoscope of MM. Lumière (see SCIENCE N. S., No. 66, p. 513), has been exhibited in a New York theater and received with much applause. A scene showing surf beating against a pier and breaking on the sand is said to have been especially successful.

THE most interesting announcement in the report of Sir A. Geikie on the Geological Survey of the United Kingdom for 1895 concerns the new general map of England and Wales on a scale of four miles to an inch. Of the total thirteen sheets, seven have been issued, five are in the hands of the engraver, and the remaining one will be shortly prepared. Experiment has been made on one of these sheets as to the comparative cost of hand coloring and color-printing; the price by the first method being 10s. 6d.; by the second, 2s. 6d. So far as can be judged at present, the sale justifies the expectation that the color-printing system may be continued and extended. Not only is there the advantage of a much lower price, but far greater accuracy of the maps can be insured than when each copy has to be laboriously copied by hand.

AT a meeting of the Royal Meteorological Society of London, on April 15th, Mr. E. D. Fridlander, gave an account of some observations of the amount of dust in the atmosphere made at various places during a voyage round the world in 1894–5. The experiments, which were made with a form of Aitken's pocket dust counter, showed that there are often considerable variations in the number of dust particles in a very short space of time. Not only did the dust occur in the air of inhabited countries, over the water surfaces immediately adjoining them, and up to an altitude of 6,000 or 7,000 feet amongst the Alps, but it was also found in the open ocean, and that so far away from any land as to preclude the possibility of artificial pollution, and its existence has been directly demonstrated at a height of more than 13,000 feet.

IN a letter received by the American Metric Society, G. Q. Coray, the Secretary of the Utah Metric Society, conveys the information that the metric system has been under constant agitation in Utah for nearly two years. As a result, practically every teacher, merchant and political leader is committed to the policy of adopting the system to the exclusion of all other weights and measures at as early a date as possible. The metric system has been recognized by constitutional provision, and unless Congress takes some action that will operate against the system in the near future the metric system will take the place of the old systems in the arithmetics used in the Utah public schools. The State Teachers' Association, the Legislature of Utah and the State University have forwarded memorials to Congress asking for the passage of the bill now before the House of Representatives. It is expected that the Salt Lake Chamber of Commerce will take similar action. The Utah Society proposes to send a representative to Washington to bring the merits of the system to the attention of the Congressmen. Mr. Coray states that the business men of Utah are practically a unit in favor of the movement. The Metric Society numbers over 1,000 members, and is composed largely of the business classes. The success of the Utah Metric Society naturally suggests the formation of similar societies in each of the States.

THERE will be an exhibition of horseless carriages at the Imperial Institute, London, beginning on May 9th, and at the Crystal Palace during May an exhibition will be opened for carriages of all sorts in which competitions will be arranged for horseless carriages.

THE *British Medical Journal* states that M. Duclaux, the Director of the Pasteur Institute, has made some interesting experiments on the chemical action of the sun's rays. The activity of the rays was estimated by exposing solutions of oxalic acid of known strength to their action.

The oxalic acid is converted with more or less rapidity into carbonic acid, which escapes, and at the end of the experiment the degree of acidity of the solution indicates the amount of the oxalic acid which has been decomposed, or 'burnt,' to use M. Duclaux's term. The results showed, as was to be expected, that with an overcast sky the chemical action of the sun's rays was much less than on a fine day, but beyond this they were far from concordant. With a dappled sky or with light cumulus clouds the solar combustion might be more active than with a blue sky or with a slight amount of cirrus. In a word, the apparent fineness of the body is not in any way related to its chemical activity and its hygienic power. On the whole, however, the action was greater in August than in September. This is in accordance with the experience of every photographer. As accounting partly for the discrepancies found between succeeding days both equally fine, M. Duclaux states that all essential oils and the odors sent forth into the air by vegetation diminish the actinic power of the radiations which reach the surface of the soil.

THE fourth International Congress of Criminal Anthropology will be held at Geneva, August 25–29, 1896. Application for membership should be sent to M. Maurice Bedot, Musée d'histoire naturelle, Geneva, Switzerland.

THERE has been established in Amsterdam, under the editorship of Dr. F. H. A. Peypers, a journal devoted to the history and geography of medicine.

THE Rebman Publishing Co., London, has in press a serial entitled *Archives of Clinical Skiagraphy*, edited by Dr. Sidney Rowland. The first plate will be the osseous system of a child, and five further plates, showing obscure injuries to the knee, etc., will be included in the first part.

THE *British Medical Journal* states that Dr. Edward Frankland has been asked to preside over the Toronto meeting of the British Association. It was at one time thought that the office would be accepted by the Prince of Wales, but he has decided that he would be unable to go to Canada next year.

THE *Naturwissenschaftliche Rundschau* states that the Academy of Science at Munich has awarded the Liebig gold medal to Prof. Friedr. Stohmann, of Leipzig, and the silver medals to Prof. B. Tollens, of Göttingen, and Dr. P. Sorauer, of Berlin. Prof. Tollens has also received an award of 1,000 Marks for his research on carbohydrates.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. LYDIA BRADLEY, of Peoria, Ill., has made known her intention of giving $1,000,000 for a polytechnic institute in Peoria.

A BOSTON citizen whose name is withheld has given $100,000 to establish a chair of comparative pathology in the medical school of Harvard University.

MRS. J. S. T. STRANAHAN, of Brooklyn, has given $5,000 to the building fund of Barnard College.

THE Catholic University will build a dormitory costing about $60,000 and accommodating about 50 students. It will be ready for use next October. There are at present no dormitories belonging to the universities. The University has received $5,000 by the will of the Rev. Father Dougherty, of Honesdale, Pa.

IT is expected that Mayor Strong will approve the bill authorizing the Board of Estimate and Apportionment to give the College of the City of New York $175,000 a year instead of $150,000, the amount it has received for several years.

OF the twenty-four fellowships annually awarded by Columbia University, the following appointments have been made in the sciences coming immediately within the scope of this journal: C. J. Keyser, *mathematics;* J. G. C. Cottier, *mechanics;* F. Schlesinger, *astronomy;* F. L. Tufts, *physics;* H. C. Sherman, *chemistry;* D. H. Newland, *geology;* P. A. Rydberg, *botany;* H. E. Crampton, Jr., and J. H. MacGregor, *zoölogy;* S. I. Franz and L. B. McWhood, *psychology.*

AT Bryn Mawr College Miss F. Cook has been appointed fellow in mathematics; Miss F. Lowwater, in physics, and Miss C. Fairbanks, in chemistry. A fellow in biology will also be appointed.

THE University of Utrecht will celebrate this year its 260th anniversary, the *fêtes* beginning on June 22d. The many American students and professors going abroad during the summer will find this a favorable opportunity to visit Utrecht.

THE late Mrs. Nichol, of Edinburgh, has bequeathed $10,000 to Edinburgh University, to found a scholarship in physics.

PROF. J. PERRY has been appointed to the vacant chair of mechanics and mathematics at the Royal College of Science, London.

THE University of Edinburgh has conferred the degree of LL. D., on President F. A. Walker, of the Massachusetts Institute of Technology.

THE Senate of Glasgow University has conferred the degree of LL. D., on Prof. Thiselton-Dyer and on Prof. Andrew Gray.

DR. ALBERT FLEISCHMANN has been promoted to an assistant professorship in the University of Erlangen and has been appointed director of the Zoölogical Institute. Dr. George Rörig, of the Agricultural High School at Berlin, has been appointed assistant professor of zoölogy in the University of Königsberg.

DISCUSSION AND CORRESPONDENCE.

THE MATERIAL AND THE EFFICIENT CAUSES OF EVOLUTION.

PROFESSOR BROOKS states in the last number of this journal that he is glad to find that after much irrelevant discussion one reader (M. M., SCIENCE, Apr. 3d) has found the thesis of his article on *Science and Poetry* (SCIENCE, Oct. 4, 1895) worthy of serious consideration. Now it seems to me on the contrary that M. M. does not discuss Professor Brooks' views, but simply points out the ambiguity of his phrase 'test of truth.'

I should suppose that no one outside of a madhouse would dispute Professor Brooks' view that conceivability is not a sufficient test of truth. Whether or not conceivability is a necessary condition of truth depends somewhat on what is meant by 'conceivability,' which is a comparatively new word, and is used by Professor Brooks with some latitude. If it be inconceivable to him that the image on the retina is inverted, then of course conceivability is not for him a necessary condition of truth. Whether or not a proposition which would commonly be regarded as inconceivable—as that a straight line may enclose an area—could in a special case be proved true by evidence, and if so whether the proposition would continue to be inconceivable, are questions which M. M. does not discuss.

At the risk of again being accused of irrelevancy by Professor Brooks, neither shall I discuss these questions, but wish to make clear a distinction analagous to that pointed out by M. M. In discussions on the theory of evolution we find Neo-Darwinians saying that 'natural selection' is the cause of the origin of species, and Neo-Lamarckians saying that the environment and the movements of the animal are the causes of adaptations. Now in these cases the word 'cause' is used ambiguously, ignorance of the facts of evolution being concealed by the exhibition of ignorance of logic.

I wonder how many men of science have read Aristotle, or understand his distinctions between material, efficient, formal and final causes. We are not here concerned with a formal cause, the idea or plan of a thing, nor with a final cause, the end for which it is made; but no student of organic evolution can afford to ignore the distinction between material and efficient causes, or between the occasion and the efficient cause of an event. The material cause is that of which a thing is made, one of the occasions or necessary conditions of its existence; the efficient cause is that which produces a thing and makes it what it is. When no qualification is used *cause* should mean efficient cause or *vera causa*.

'Natural selection' is no cause of the origin of species, but may be the cause of the anihilation of unfit species. Whether or not the environment, or consciousness, or the movements of animals are causes of hereditary modifications are open questions. What is called the cause of an adaptation is, however, usually only its occasion. Thus at a recent meeting of the

New York Academy of Sciences Prof. Osborn, in arguing that the environment is one of the causes of adaptations, stated that lime is the cause of teeth, because teeth depend on the existence of lime and vary with its abundance. It is true that there could be no teeth if there were no lime, but teeth do not result from the mere presence of lime in the environment. Lime is one of the material causes and occasions of teeth, but it has not been shown that it is their efficient cause. It would seem that the environment is more often the cause of the destruction of life than the cause of its development.

J. MCKEEN CATTELL.

COLUMBIA UNIVERSITY.

INSTINCT.

IN Prof. Mills' communications on 'Instinct' he seems to have missed the point in the case of each of those criticised—the 'writer of the note,' Prof. Morgan and myself. In the case of the fowl's drinking, it is not the mere fact that drinking and eating may differ in the degree to which the performance is congenital; the reports seem to show that this varies in different fowl; but that instincts (in this case drinking) may be only half congenital, and may have to be supplemented by imitation, accident, intelligence, instruction, etc., in order to act, even when the actions are so necessary to life that the creature would certainly die if the function were not performed. That is the interesting point.

Then, in criticising me, Prof. Mills accuses me of ignoring the 'effects of environment and of use.' On the contrary, these are just the facts which I appeal to. By adaptations to the environment and by use the creature manages to keep alive; other creatures die off; so certain determinate directions of congenital variation are singled out and inherited. Thus phylogenetic variations become determinate, just through these ontogenetic adaptations. This takes the place of the Lamarckian factor. Lamarckism is an 'obvious' resort in all cases, of course, but it seems to me so easy that in many cases it is shallow in the extreme.

But my view is very far from being Weismannism. I reach determinate variations by means of new functions or adaptations which keep certain animals alive to propagate. It is really a new theory, as Prof. Osborn, who has reached about the same point of view, declares. This is also just the value which Prof. Morgan attaches to his observations.

J. MARK BALDWIN.

PRINCETON, April 17, 1896.

STUDIES IN THE MORAL DEVELOPMENT OF CHILDREN.

The Relation of the Child to Authority.

IT is desired to obtain data for a study of the attitude of young children toward parental authority, with a view to determining what sort of discipline, instruction and appeal is best calculated to develop in children a proper recognition of the parent's authority and a readiness to submit to it.

Parents who are willing to aid in the investigation are requested to carry out the following experiments, and to report the results.

1. Try different punishments for the same offence, as follows:

(*a*) *For Naughtiness at Table:* (1) Corporal punishment, though not necessarily severe. (2) Sending the child away from the table, with permission to return as soon as he is ready to be good. (3) Having the child eat by himself in the kitchen.

(*b*) *For Sauciness to Parents:* (1) Corporal punishment. (2) Sending the child into the bedroom to stay till he is ready to take back what he said. (3) Refusing to caress the child or to be caressed by him until he is ready to make up and say he is sorry. Of course, it may sometimes be hours after the offence before occasion is given for applying this last penality, the parent meanwhile seeming to have ignored the offence. If the child has not made up before bedtime, then put him to bed without his usual kiss, explaining why you do so.

(*c*) *For Taking a Toy Belonging to a Playmate* (whether by force or stealth), with a resulting outcry on the part of the playmate: (1) Compelling the child by corporal punishment, or the threat of it, to return the toy to the playmate. (2) Taking the toy away by force and returning it to the playmate, and sending the child into the bedroom for five minutes. (3) Giving one of the child's favorite toys (not at the time in his hands) to the playmate, and allowing him to keep it until the child wants an exchange badly enough to ask it of the playmate, apologizing as he does so for having taken his toy.

Remarks: (1) Try the experiments as to punishment on children from three to six and one-half years old. (2) In each case try the suggested penalties in the order given, and make two trials of each before passing to the next. (3) In no case carry the corporal punishment to the extent of 'breaking the child's will.' (4) If you object on principle to corporal punishment, state it in your record, and try the two remaining penalties in the order given.

What to Record: (1) Which of the three penalties is most effective in securing reform, and which the least so? (2) Which penalty arouses most feeling against the parent, and which the least? (3) Such actions or comments of the child during, or with reference to, the punishment as seem to you worthy of note.

II. Give commands varying in arbitrariness, as follows:

(*a*) Shut the door, so the room won't get cold.

(*b*) Carry this book into the bedroom and put in on the bed.

(*c*) Move that chair to the other side of the table. * * * Now move it back where it was.

(*d*) A double experiment. (1) Pick up these pieces of paper (a dozen pieces which you have thrown on the floor in the child's absence). (2) On another occasion throw a dozen pieces of paper on the floor while the child is looking, and request him to pick them up.

Remarks on the Above Experiment: (1) Give the commands only to children between two and one-half and four and one-half years of age. (2) Give the several commands at different times, and to each child separately. (3) Give the commands seriously—in such a way that the child will not think you are in fun. (4) Give them when the child is in good humor and behaving well, so he will have no reason to think he is being punished. (5) If the child meets any of the questions with a 'why?' say gently, but firmly, 'Because I told you to.'

What to Record: (1) In the case of what commands the child asks 'why?' (2) Whether he shows surprise at any of the commands; and if so, which excite most surprise. (3) Any objections or comments the child may make. (4) How readily the several commands are obeyed, especially which are most reluctantly obeyed. (5) Whether any of the commands provoke indignation or anger in the child.

III. Effect of the manner in which commands are given.

Determine through observation and experiment: (*a*) What mode of giving a command secures the *quickest* obedience. (*b*) What mode secures the most *willing* and *cheerful* obedience.

Note especially how the child is affected by sharp and abrupt commands, as compared with the effect upon him of commands given in gentle but firm tone. (Commands may also be: direct or interrogative, *i. e.*, 'do this,' or, 'will you do this?' and with or without a 'please.')

IV. Compare the effect of Praise upon the child with the effect of Censure, as follows:

(*a*) *To produce in the child a love of cleanliness* —as to face, hands and dress: (1) Ignoring the occasionally clean and neat appearance of the child, make frequent disparaging remarks about his dirty face and hands, and censure him when he soils his clothes in any deliberate or careless manner. (2) Ignoring the usually more or less untidy appearance of the child, praise him warmly whenever he has washed himself (or cheerfully allowed himself to be washed) and appears *exceptionally* neat and clean.

(*b*) *To secure good behavior of the child during the father's absence:* (1) Let the mother in reply to the father's inquiries as to the child's conduct during his absence, relate wherein the child has been naughty, and let the father censure him for his conduct. (2) When the child has been *unusually* good, let the father, in the hearing of the child, inquire about his conduct, and when the mother has praised him warmly for his good behavior, let the father add his commendation.

Remarks: (1) Make the trial of Praise *vs.* Censure on children from three to six and one-half years old. (2) Give the first method of procedure a fair trial before trying the second.

What to Record: (1) Which method you find the more effective in securing the desired result. (2) The approximate number of trials made of each method before reaching your conclusion.

V. How does Pretending to Cry, on the part of the parent, affect the child: (*a*) As a deterrent from disobedience?

(*b*) In making him sorry for obedience? (Try this experiment but a few times, and only on children from two to four years old.)

VI. Observe the child's comments on hearing the following stories, and endeavor to elicit his moral judgment regarding each of the two incidents:

(*a*) One day a lady gave a stick of nice, red candy to a little girl, named Bessie (or to a little boy, named Robbie, if the child to whom you are telling the story is a boy). Bessie took the candy home and showed it to her mamma. Her mamma said, "How nice it looks; you must give it to me, to eat." Bessie said, "I won't! the lady gave the candy to me, and I want it myself." Then mamma took the candy away from Bessie and whipped her because she wouldn't give the candy to mamma. (Will the child see the arbitrariness of the command and of the punishment?)

(*b*) One day mamma gave Bessie (or Robbie) a pitcher full of milk, and told her to carry it into the pantry and put it on the shelf. Bessie walked very carefully, so as not to spill the milk; but when she came to the pantry door her little sister, Ella (or his little brother, Jamie), ran against her and made her drop the pitcher. The pitcher broke all to pieces, and the milk ran all over the floor. Then mamma scolded Bessie and sent her into the bedroom, because she broke the pitcher and spilled the milk. (Will the child see the injustice in the mother's treatment of Bessie? If so, what treatment will the child propose?)

Remarks: (1) Tell the stories to children from three to six and one-half years old. (2) Tell the two stories at different times and to each child separately. (3) In trying to elicit the child's judgment, be careful not to suggest ideas.

General Information. By way of introduction to your record of the results of the above experiments, state: (*a*) The child's *nationality.* (*b*) His *age in months* when the several experiments are tried. (*c*) Whether he is a *normally strong* and healthy child, physically and mentally. If not, in what way he is less well or strong than the average child. (*d*) His *peculiarities of temperament*, especially how far he is naturally *irritable, obstinate or domineering.*

Parents who are willing to aid in the above investigation are requested to send at once to the undersigned: (*a*) their own names and addresses. (*b*) The names and respective ages (in months) of the children that are to be observed.

The information secured in response to this paper will be used in a general and statistical way, without publication of names.

It is hoped your observations may be completed, and the report of results sent in, within two, or, at most, three months after your receipt of this paper; but as much time should be taken as is necessary for accurate and full results. Address, J. F. MORSE.

WISCONSIN UNIVERSITY, MADISON, WIS.

SCIENTIFIC LITERATURE.

Frail Children of the Air. Excursions into the world of butterflies. By SAMUEL HUBBARD SCUDDER. Boston and New York, Houghton, Mifflin Co. 1895. $1 50.

This will prove a delightful book for the coming summer season. Although its title may not be especially descriptive of the contents, the book is devoted to an account of the more interesting peculiarities in the structure, lives, and habits of our commoner butterflies. The subjects treated are the following: Butterflies in disguise, the struggle for existence in the genus Basilarchia, deceptive devices among caterpillars, butterflies as botanists, the names of butterflies, color-relations of chrysalids to their surroundings, the White Mountains of of New Hampshire as a home for butterflies, butterfly sounds, nests and other structures made by caterpillars, postures of butterflies at rest and asleep, the eggs of butterflies, psychological peculiarities in our butterflies, social caterpillars, the fixity of habit in butterflies, how butterflies pass the winter, the oldest butterfly inhabitants of New England, protective coloring in caterpillars, aromatic butterflies, the ways of butterflies, and similar topics. Those who are fortunate enough to possess or to have seen Dr. Scudder's great work: 'The butterflies of the eastern United States and Canada,' a work so costly as to have but a limited circulation, will recognize these chapters, which form the delightful excursuses of the two volumes of text. They are charmingly written, and are mainly the result of the author's own observations, and in their present form deserve the widest reading. It would prove a beautiful present for a boy or girl interested in insects, and also afford pleasant summer reading for older minds, since few technical terms are used.

There are a number of plates containing figures reproduced from the larger work. In the matter of index, printing, paper and general appearance we not only have no fault to find, but everything to commend. A. S. P.

Third Report of the Board of Managers of the New York State Colonization Society, by O. F. Cook, Fulton Professor of Natural Sciences in Liberia College. 1896. 8°, 100 pp.

This report is a plain recital of careful observation on plants, animals, and men in the Republic of Liberia; the observations are recorded in simple, straightforward fashion, and are of considerable interest and value, albeit in an unexpected medium.

Over 30 pages are devoted to the flora and fauna; 30 or 40 plants are identified in an annotated list, and the notes touch on a variety of characteristics and uses of the plants and their products; *e. g.*, it is pointed out that the seeds of the mangrove germinate on the trees, sending out long sharp-pointed radicles, which hang pendent until the weight breaks attachments, when they drop into the mud and are thus planted right side up and so firmly as to resist tidal currents; *Urena lobata* 'is protected by ants for the sake of a secretion which is elaborated and exuded by a small gland at the base of the midvein;' the banana and bread fruit flourish, yet their products cannot be made exclusive articles of diet, as is commonly supposed, etc. There is a surprising dearth of mosses and parasitic fungi and lichens in Liberian forests, and it is noted that 'in nearly all natural groups the number of species is much larger than in the same area in North America, even though the number of individuals may be less for the group as a whole' (page 5). There is a comforting dearth, also, of snakes, mosquitoes, flies and minor pestiferous insects, which seems to be correlated with the wealth of ants, both in species and individuals. The habits of the 'driver' ants, the natural scavengers of the district, are described in detail, as are those of the termites, which appear to cultivate a fungus to supply food for the young and the queens. It is noted that the chimpanzees (called by the natives 'old-time people') dig land crabs out of their burrows and crack them on stones,* and are said also to crack nuts between stones, 'quite man fashion,' and to grasp the python by the neck and bruise its head with a stone (page 22).

The social conditions of Liberia are described in fair detail; and it is shown that, while slavery is prohibited by the Liberian constitution, there is a modified slavery of hireling service which has degraded the servitors and still more seriously enfeebled the served, who 'rarely gain habits of industry or self-reliance, and with no proper school advantages * * * reach maturity too often as examples of physical and mental weakness' (page 45). Even more interesting is the naïve description of the 'missionary slave trade,' from which it appears that evangelization begins with actual purchase of the youth whom it is desired to Christianize and civilize! "In the interior of Liberia [slave] boys 12 and 14 years old were offered me for goods of a cash value of about $3. Girls come at about twice the price. * * * * When it comes to buying free children of their parents the price may exceed the figures mentioned" (page 40). "The only apparent reason why this department of the slave trade has not assumed proportions sufficient to attract general attention, has been the lack of funds in the hands of the would-be buyers" (page 38). In

*Major Battersby, in describing the 'Pets and Pests of the Barbadoes' (*Chambers Journal*, March 14, 1896), mentions a Capuchin monkey which captures crabs in related fashion: "His method * * * is to knock it about with his paw by quick pats until it is sufficiently dazed to give him a chance of smashing its claw with a large stone" (*Literary Digest*, Vol. XII., 1896, p. 717).

one case a missionary intending to remove to Angola was not permitted to carry her purchased pupils with her; 'thus has a negro government interfered to prevent a white missionary from taking native children 2,000 miles from their parents and kindred, in accordance with the plans of a missionary bishop' (page 43). The text contains comparatively little of ethnic interest save in scattered morsels, for, as is usual in evangelizing and civilizing enterprises, it is considered that no good thing can come from the Nazareth of the primitive; but some of the mechanically reproduced photographs illustrate the features, costume and customs of the natives, the appearance of their barricaded towns, etc., while the numerous cuts give faithful pictures of flora and landscape, and admirably supplement the simple and modest description in depicting Liberia as it is.

It is announced that the society, though retaining its original name, long since gave up its adherence to any scheme of colonization, as such, and now confines its activities to education and practical questions. A note indicates that additional copies of the report can be obtained by applying to Charles T. Geyer, Secretary, 19 William street, New York City.

W J McGEE.

WASHINGTON, D. C.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE May number opens with an article by John Trowbridge, discussing the probable presence of carbon and oxygen in the sun. This is in the line of work earlier done (1887) by the same author in combination with C. C. Hutchins, in which they showed that the carbon bands could probably be detected in the sun's spectrum, although nearly obliterated by the overlying absorption lines of other metals, particularly those of iron. Some quantitative experiments have been now carried out by the author to show what relative proportion of iron mixed with carbon dust was required in order to produce this effect of obliterating the carbon bands. Pencils, made of carbon dust and iron (reduced by hydrogen) uniformly distributed through it, were employed. The solar spectrum near the carbon band at wave-length 3883.7 was then photographed, also below on the same plate the pure carbon banded spectrum, and finally, immediately below this, the spectrum of the mixture of iron and carbon. It was found that from twenty-eight to thirty per cent. of iron, in combination with seventy-two or seventy per cent. of carbon, almost completely obliterated the peculiar banded spectrum of carbon. This proportion, therefore, of iron in the atmosphere of the sun, were there no other vapors of metals present, would be sufficient to prevent our seeing the full spectrum of carbon. The author then goes on to consider the case of oxygen and remarks that the question whether oxygen exists in the sun is closely related to questions in regard to the presence of carbon, when the temperature and light of the sun are considered. The regions in the solar spectrum where the bright lines of oxygen should occur if they manifest themselves have been carefully examined in order to see if any of the fine absorption lines of iron in the spectrum of iron were absent, for it is reasonable to suppose that the bright nebulous lines of oxygen would obliterate the faintest lines of iron. The result is to prove that the faintest iron lines are not obliterated in the spaces where the oxygen lines should occur.

The author concludes by remarking that, although he has not succeeded in detecting oxygen in the sun, it seems to him that the character of its light, the fact of the combustion of carbon in its mass, the conditions for the incandescence of the oxides of the rare earths which exist, would prevent the detection of oxygen in its uncombined state. Notwithstanding the negative evidence brought forward, he adds that he cannot help feeling strongly that oxygen is present in the sun and that the sun's light is due to carbon vapor in an atmosphere of oxygen.

An extended article by Harold Jacoby gives a minute mathematical discussion of the determination of the division errors of a straight scale. T. Holm gives the results of studies upon the *Cyperaceæ*, with reference to the monopodial ramification in certain North American species of *Carex*. It is shown that the monopodial character is especially well represented on this side of the Atlantic and may indeed be said to be prevalent among our sylvan forms. The article is accompanied by a plate. W. H. Weed and L. V. Pirsson give a continuation of their paper on the Bearpaw Mountains of Montana, commenced in the April number. This is devoted to the discussion of the Beaver Creek core with reference to the massive rocks there present. These are of various types, ranging from quartz syenite and quartz syenite poryhyry to basic syenite (or, as the rock has been called by Brögger, monzonite), and finally to shonkinite. It is remarked by the authors that their yogoite already described from Yogo Peak, Montana, is essentially identical with monzonite, and hence the latter name has priority.

M. Carey Lea has two brief articles. The first discusses the question of the presence of Röntgen rays in the sunlight, and decides this in the negative. A number of conclusive experiments are described, upon which this decision is based. The second article is on the numerical relation existing between the atomic weights of the elements, especially with reference to the colored and colorless character of the ions. This last subject was discussed by the same author in the *American Journal* for May, 1895, and a second paper is promised for June of this year. W. B. Clark describes minutely the Potomac River section of the Middle Atlantic Coast Eocene, showing the seventeen divisions identified in the detailed stratigraphy of the deposits as exhibited particularly between Aquia Creek, Stafford county, Virginia, and Pope's Creek, Charles county Maryland. It is concluded that the Eocene deposits of the Middle Atlantic slope constitute a single geological unit which has been described as the Pamunkey formation. The deposits are remarkably homogeneous, consisting typically of glauconitic sands and clays of a thickness of nearly 300 feet. There are two well-defined faunal zones, namely, the Aquia Creek stage and the Woodstock stage. The former approximately corresponds to the middle, or middle and upper, Lignitic, and the latter to the middle, or middle and upper, Claiborne. The author concludes by remarking that the middle Atlantic slope Eocene undoubtedly represents in a broad way all of the major part of the Lignitic, Buhrstone and Claiborne of Smith and, when the physical condition affecting range and migration of species are considered, perhaps even more. Both the geological and paleontological criteria are wholly inadequate for establishing the great number of local subdivisions recognized in the Gulf area, and in fact the sequence of forms indicates that no such differentiation of the fauna took place.

H. S. Washington describes some peculiar Ischian trachytes with special reference to certain remarkable branching forms exhibited by the feldspar phenocrysts; these are analogous to the feather-aggregates of augite which have been described in some Hawaiian basalts. For such divergent crystal forms, which are regarded as due to the ramification and growth of a single individual, and which correspond to the *sphærokrystalle* of Lehmann and Rosenbusch, the name *keraunoid* (Gr. κεραυνός, a thunderbolt), is proposed. The existence of such forms has been explained by Lehmann as due to internal tensions which cause the crystals to split here and there at the surface, producing a discontinuity which cannot be overcome by further growth. The author adds the results of his own observations as modifying and extending the results of Lehmann, and concludes by considering the various types of spherulites in general. The articles close with a paper by C. Palache describing some highly modified crystals of crocoite, from a hitherto undiscovered locality in Tasmania.

AMERICAN CHEMICAL JOURNAL, APRIL.

The action of light on some Organic Acids in the presence of Uranium salts. By HENRY FAY.

After reviewing previous work on this subject the author gives the results obtained with oxalic, butyric, propionic and acetic acids. From oxalic acid he obtained carbon dioxide, carbon monoxide, formic acid and several uranium compounds. When the acids of the acetic acid series were used, equal parts of carbon dioxide and the hydrocarbon corresponding to the acid were formed. Succinic and malonic acids could not be used on account of the insolubility of the uranium compounds.

A review of some recent work on Double Halides. By CHARLES H. HERTY.

In this paper attention is called to the character of recent work on these compounds and the apparent ignorance of published results, and a plea is made for greater care and accuracy in the preparation and analyses of these salts.

On the Quantitative Determination of Hydrogen by Means of Palladous Chloride. By E. D. CAMPBELL and E. B. HART.

The hydrogen contained in a gas mixture can be completely absorbed by a 1 per cent. solution of palladous chloride, and determined more easily that way than by explosion with oxygen.

On the Behavior of Certain Derivatives of Benzol Containing Halogens. By C. LORING JACKSON and S. CALVERT.

The presence of certain groups in a substituted benzine, containing also a halogen, makes the halogen more easily replaceable. The effect of the nitro group has been carefully studied, and in this paper the authors give the results of the influence of halogens on halogens, according to their number and position in the molecule.

The Cis and Trans Modifications of Benzine Hexabromide. By W. R. ORNDORFF and V. A. HOWELLS.

The authors have made the cis modification of benzine hexabromide, and give the results of the chemical and crystallographic study of the substance.

Silicide of Calcium. By G. DECHALMOT.

When lime, carbon and silica in excess are heated in an electric furnace, a substance of metallic appearance is formed.. This is mainly silicide of calcium, with a little carbide of calcium and iron.

The Conductivity of Yhtium Sulphate. By H. C. JONES and C. R. ALLEN.

The conducting of different dilutions are given in this paper.

The Practical Use in the Chemical Laboratory of the Electric Arc Obtained from the low Potential Alternating Current. By M. S. WALKER.

The author advises the use of the electric arc in the laboratory as a partial substitute for the blowpipe, to show the effects of high temperatures on refractory substances, and for the synthetical preparation of some compounds of carbon.

The Preparation of Allylene and the Action of Magnesium on Organic Compounds. By E. H. KEISER.

When acetone is conducted over hot magnesium a black powder is formed, which decomposes when brought in contact with water. The product consisting of hydrogen and allylene is passed through an ammoniacal solution of silver nitrate, when an insoluble silver allylide is formed. The copper and mercury compounds have also been made.

The Action of Urea and Sulphocarbanilide on Certain Acid Anhydrides. By F. L. DUNLAP.

The formation of a number of complex compounds can be explained on the supposition that the reaction takes place in two stages, and the author has isolated some of the intermediate products.

There is also a review of the work on *Elektrochemie*, by W. Ostwald, and a note on *The Dilution Law of Ostwald.* J. ELLIOTT GILPIN.

THE JOURNAL OF COMPARATIVE NEUROLOGY, MARCH.

Illustrations of Central Atrophy After Eye Injuries. By C. L. HERRICK.

This brief article is a commentary on a plate of drawings made from two series sections of the brains of rabbits whose eyes had been extirpated shortly after birth and which had been killed respectively 67 and 91 days after the operation.

Lecture Notes on Attention. An Illustration of the Employment of Neurological Analogies for Psychical Problems. By C. L. HERRICK.

Experiments are adduced which go to show that external attention is of the nature of a reflex which may or may not retain a relation of subordinated connection with conscious processes. Which particular impression may be selected out of a given sense complex for especial attention will depend upon habit mainly. All of the impressions of a given field of sense may become the content of that sense and so may exert their appropriate effects in infra-conscious spheres of association, etc., even though only part of them ever reach consciousness. The discussion as to the possible number of contemporaneous sensations is based on a misconception. Though the content of sense may be diversified, only one thing is ever in the focus of consciousness at a given time. Attention becomes a set of rapidly repeated reproductions. In thinking intently of one thing we limit the field of oscillation and cut off distractions as much as possible, but the oscillations with the various resulting associations continue and give pregnancy to the meditation. Attention is a name for the play of consciousness, and a study of its laws reduces, on the one hand, to the investigation of neural equilibrium, and, on the other, to a natural history of consciousness. The conditions of inner attention are those of association and inhibition.

A Note on the Cerebral Fissuration of the Seal (Phoca vitulina). By PIERRE A. FISH.

The description and illustrations of this brain show that it clearly possesses the carnivorous type of fissural pattern, in spite of several complexities which tend to obscure the type.

Morphology of the Nervous System of Cypris. By C. H. TURNER.

This is the first instalment of a monograph on the Ostracoda which Prof. Turner has had in preparation for several years. It is accompanied by six plates. The ganglia and nerves of the central nervous system and the sense organs of Cypris are described with considerable minuteness. Labial, labral and thoracic nerves are described for the first time among the Ostracoda. Several new sense organs are also described.

Preliminary Notes on the Cranial Nerves of Cryptobranchus alleghaniensis. By J. H. McGREGOR.

In this paper the cranial nerves of the water dog are described, so far as they can be determined by macroscopic methods.

On Three Points in the Nervous Anatomy of Amphibians. By J. S. KINGSLEY.

This article corrects two errors in Von Plessen and Rabinovicz's 'Die Kopfnerven von Salamandra maculata,' the one concerning the anastomosis between the ophthalmicus superficialis and the maxillary, and the other that between the ophthalmicus profundus and the palatine nerves of Salamandra. Dr. Kingsley also points out that the tentacular apparatus recently described by Mr. Alvin Davison in Amphiuma does not exist, and therefore this point cannot be used to show the close relationship between the Cœciliidæ and the Amphiumidæ.

The remaining 44 pages of the number are devoted to abstracts and reviews.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

THE Section of Geology and Mineralogy held its regular meeting April 20th, President J. J. Stevenson in the chair.

The first paper of the evening was by Mr. John D. Irving, on 'The Stratigraphy of the Brown's Park Beds, Utah.' The observation on which the paper was based, was made by Mr. Irving the past summer, while spending a week in Brown's Park, together with Dr. J. L. Wortman and his expedition from the American Museum of Natural History, New York. Mr. Irving first sketched the topography and geology of the Green River Basin and the Uinta Mountains. He showed the location of the Brown's Park Beds and described their unconformable position upon the Uinta sandstone and the Green River shales. He next outlined the views that had already been published regarding their stratigraphical relations, especially those of Clarence King and S. F. Emmons, of the 40th Parallel Survey, who referred them to the Pliocene, and those of C. A. White, of the United States Geological Survey, who referred them to the Eocene. Mr. Irving stated that careful search failed to reveal any fossils, except a few fragments of bone, which were in such a state that Dr. Wortman considered them to be not earlier than the Pliocene. Mr. Irving then described the Lodore cañon and explained the formation of the Lake in which the Brown Park Beds were deposited as due to the Pliocene elevation of the Uinta sandstone that forms the wall of the Lodore cañon. When this was cut down by the river the lake disappeared and depositions ceased. He, therefore, corroborated the original determinations of King and Emmons. The paper will appear in full in the Transactions.

The second paper of the evening was by

Prof. C. H. Smyth, Jr., on 'The Origin of the Talc Deposits near Gouverneur, N. Y.' Dr. Smyth first described the geological surroundings of the talc and showed that it occurs along a series of belts in limestone walls and that the previously published statement that it occurs in gneiss is incorrect. By means of microscopic sections he traced its development by the alteration of tremolite in largest part and from enstatite to a less degree, the changes in both having been affected through the agency of water and carbonic acid. The talc occurs in two forms—a scaly variety, or talc proper, and a fibrous variety or agalite. He was unable to determine whether the original rock was a basic intrusive or a siliceous magnesian limestone. The full paper will appear in the *School of Mines Quarterly* for July, 1896.

The third paper of the evening was by Prof. H. P. Cushing, and was entitled 'Are there Pre-Cambrian and Post-Ordovician Trap Dykes in the Adirondacks.' Field work in Clinton county, N. Y., had convinced the writer that there were two periods of dyke intrusion in the Adirondacks. The first yielded the porphyries or bostonite, the Camptonites and non-feldspathic dykes, which cut the Paleozoic strata up to and through the Utica slate. These dykes, are chiefly limited to the shores of Lake Champlain, both in New York and Vermont. They practically lack diabase. The second set are limited to archean rocks, are much more numerous and are practically all diabase. One hundred and sixteen dykes in all are known in Clinton county; sixteen belong to the first series, while the remaining one hundred belong to the second. The latter have been found in the gneisses in many cases very near the contacts with the Potsdam sandstone, but in no case have they been found penetrating the sandstone. The same relations have been noted by Smyth at the Thousand Islands.

Prof. Cushing therefore urged that these dykes should be considered a separate series of rocks that had been formed subsequently to the metamorphism of the crystalline rock and before the deposition of the Potsdam sandstone. The paper will appear in full in the Transactions.

J. F. KEMP,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 259TH MEETING, SATURDAY, APRIL 4.

THE first paper of the evening was *Pfaff's Recent Investigations on Rhus Poisoning*, and was presented by V. K. Chesnut. The writer briefly analyzed the work of preceding investigators and showed how the different ideas regarding the volatile nature of the poison were influenced by successive stages in the development of the science of Organic Chemistry and it was shown that nothing but an oil, like Toxicodendral, could produce the effects of poison ivy. Experiments and authentic cases of poisoning were described to corroborate Pfaff's statements that:

1. While water will not remove the oil from the skin an hour after contact, alcohol will do so very readily, especially when added in successive portions.

2. The poison is readily communicated to different parts of the body and to other persons by contact and friction.

3. The wood, as well as the leaves, is poisonous and the active principle is present in the plant at all times of the year.

4. Herbarium specimens may produce the poisonous effects.

The effect of alcohol as a palliative, and of an alcoholic solution of lead acetate as an antidote was shown by experiments made by the writer upon himself.

B. T. Galloway spoke of *the Action of Copper in Poisoning Fungi*, stating that although copper in various forms had been used for years as a fungicide, little was known in regard to the exact nature of its toxic action on plants. Most of the studies made within the past 8 or 10 years had for their object the determination of the amount of copper necessary to kill the spores of various fungi. In this connection the investigations of Nageli, and the oligodynamic phenomena described by him, were reviewed. Finally the possible methods by means of which spores of fungi may be killed or prevented from infecting living plants, were discussed and attention was called to a paper on the subject by Mr. W. T. Swingle, of the Department of Agriculture, soon to be published.

Under the title of *the Story of two Salmon*

Barton W. Evermann described the spawning habits of the Blueback and the Chinook Salmon, species which had been especially investigated by him during 1894 and 1895. These species have important spawning grounds at the headwaters of the Salmon and Payette rivers in Idaho. This paper gave an account of the manner in which the investigations were conducted and a statement of the more important results obtained.

These two species of salmon are, of course, anadromous, living in the sea, and entering fresh water only for spawning purposes. They enter the Columbia from the sea in the early spring and reach the headwaters of Salmon River over 1,000 miles from the sea, about the last week in July. The spawning began about the middle of August and continued for fully a month.

It has long been known that at spawning time these salmon have their fins more or less worn out and their bodies covered with mutilations, and these injuries were believed to have been received while on the long journey to the spawning grounds. But this was proved not to be true. More than 2,000 salmon were examined as they arrived upon the spawning beds and not one showed any mutilations of any kind.

As the spawning advanced the fish began to show mutilations; the caudal, anal and ventral fins became badly worn, and often the dorsal fin and the sides of the back were injured. By the time the spawning was at its height, scarcely a fish was wholly free from mutilations. The fish were observed daily during the entire spawning period and it was discovered that all the mutilations were received while on the spawning beds, chiefly in moving the gravel of the spawning beds about, but to some little extent in personal encounters between the males.

The second important fact determined was that, after spawning, the salmon coming to that region die, none of them ever returning to the sea. They began dying soon after they had done spawning. On September 7th 1,100 redfish or blue-back salmon were counted in the inlet to Alturas Lake. On September 16th only 213 were left, and on September 22d there were scarcely any left. None had been caught out of the stream, but all had died. The fish showed no tendency to return down stream.

F. A. Lucas,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, APRIL 11, 1896.

The 116th regular meeting was held in Baltimore on invitation of Mr. P. R. Uhler. Mr. Howard exhibited specimens of *Margarodes vitium* Giard, from South Africa. The locality is a new one, as the species has previously been found only in Chile and Argentina. Referring to a recent note by Valery Mayet, Mr. Howard suggested that the insect is now likely to be carried to many parts of the world in any earth which may occur around exported plants. Mr. Schwartz exhibited specimens of *Coleocerus marmoratus* and an undescribed Tychius, to illustrate two modes of variation brought about by different position and development of the scales. In the Coleocerus, some specimens are uniformly covered with large white scales, which in others are replaced in spots by brown scales of smaller size. In the Tychius some specimens have the elytra variegated with spots and lines composed of large white scales; in other specimens the positions which should be occupied by these scales are covered with a spongy mass which a high magnifying power shows to be composed of the white scales in a collapsed or undeveloped condition. In these specimens the development of the scales has apparently been arrested. Mr. Schwarz also exhibited a new Apion and two species of Anthonomus, one new and the other *A. leucostictus* Dietz, which he had reared from the seeds of *Xanthoxylum pterota*, at San Diego, Texas.

Dr. Henry Skinner, of Philadelphia, read a paper embodying his views on specific values, and illustrated his remarks with many examples drawn from the Rhoyalocera, insisting that morphological species are tentative and must be tested by a study of the life history and geographical distribution.

Mr. Ashmead read a paper on the genera Stephanus, Megischus and Megalyra and their position in the Hymenoptera, concluding that the family Stephaidæ does not deserve family rank and that the three genera should be placed among the Braconidæ in a subfamily which he called Setphaninæ.

Mr. Uhler made some remarks on the 'schlussfeld' of certain Cicadidæ, tracing the development of this basal fold in the hind wings throughout Cicadas from many parts of the world and suggesting its connection with the rapidity of flight of the species. Mr. Benton spoke of the proposed introduction of *Apis dorsata* into the United States, giving an account of previous attempts and particularly of his own journey some years ago to Ceylon in search of this giant bee of India. He described the methods by which he secured colonies and gave an account of the habits of the bee and the character of its nests. He desired the opinion of the Society as to the possibility of the successful introduction of this bee into the United States and the desirability of such introduction. The paper was briefly discussed by Messrs. Mann, Skinner, Schwarz, Ashmead and Stiles.

L. O. HOWARD,
Secretary.

NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

AT the meeting of the Section held on the 10th inst, at the College of the City of New York, Prof. Birchmore exhibited on the screen the absorption spectra of a number of aniline and other colors, including eosin, aniline red ultramarines, potassium permanganate, cudbear, etc., and explained the effect of certain reactions with ammonia and other reagents on the size and position of the absorption bands.

Dr. Birchmore also explained an arrangement of adjustable colored prisms projecting through the opposite sides of a cylinder, to be filled with a liquid having the same refractive index as glass: oil of juniper was mentioned; whereby the colors of the Nessler reagent in ammonia determinations could be recorded.

The description of this apparatus was brought out in the discussion of Dr. Albert R. Leeds' paper on 'Standard Prisms in Water Analysis, and the Valuation of Color in Potable Waters,' in which Dr. Leeds described his first attempts nearly twenty years ago to obtain suitable standards of comparison, using solutions of various kinds, colored glass plates and colored glass prisms. He reviewed the progress which has been made in the matter, and recommended the appointment of a committee to unify the methods and adopt a standard.

Prof. C. L. Speyers read a paper on 'Matter and Energy,' in which he discussed the more recent views of Ostwald.

Dr. E. G. Love exhibited some remarkably fine microphotographs of several varieties of starch.

Dr. L. Saarbach exhibited an improved form of laboratory temperature regulator, which has not only the advantage of small cost, but can be taken apart, cleaned and adjusted with the greatest ease. It may be arranged for high or low temperatures and for almost any degree of sensitiveness. It is practically an air thermometer, but can be adjusted to different degrees of sensitiveness by replacing more or less air, by mercury.

Prof. Breneman, chairman of the committee appointed to consider the organization of a chemical club, reported that he had received nearly a hundred replies to the circular sent out, all but about twenty of which were unqualifiedly in favor of the project. He stated that there had been a misunderstanding on the part of some as to the intended membership, and he desired to have it known that there is no intention of limiting the membership to any society or section of the chemical fraternity, but to include chemists and chemical manufacturers generally.

DURAND WOODMAN,
Secretary.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, MARCH 31, 1896.

'*Longshore Transportation on the North Jersey Coast.* J. EDMUND WOODMAN.

Littoral transportation is caused by wind waves, wind currents, tidal waves and tidal currents. All these factors are in active operation on the Jersey coast, but the proof is very strong that the controlling forces are tidal. The most general statement of this proof is that the winds, which must be uniform over a considerable extent of shore, act in some places in conjunction with the transportation, in others in opposition to it.

From the region east of Toms river to Sandy

Hook there is a dominant northward current; from the former place to Delaware bay a southward one. This current can be seen and traced in many places. Its geographic effect is chiefly the migration of material (and hence of inlets) from the center towards the two extremities of the State. This opposition of movement cannot be due to the fact that the northern half is in the lee of Long Island, and thus while northeast winds dominate farther south they are overpowered by southeast winds there, for at Sandy Hook or Long Branch the northeast storms are as severe as at Atlantic City.

The reason given by the U. S. C. S. (1856) for this northward movement cannot be correct; for upon examining the region we see that ever so strong a draught through False Hook channel would not cause a steady and strong current as far south as Manasquan inlet. The explanation must be sought in the effect of submarine topography upon the tides, which near shore move as waves of translation. This effect seems to be chiefly the formation of nodal points of secondary importance in the three great tidal bays of the Atlantic coast. The same phenomenon occurs on the south shore of Long Island, and on the east shore of Cape Cod. These secondary nodes are joints of divergence of currents, and must be caused by inequalites of the great continental delta which we do not now recognize.

While the author considers tidal action to be dominant here, he does not believe it to be the exclusive agent of transformation. The direction and amount depend upon the resultant of all the factors tending to produce movement, and wind waves form a veryconsiderable element in this. But that wind waves do not control it is proved by the fact that the current continues northward against adverse winds, and can only be momentarily reversed by long continued and violent storms.

Transportation is mainly off-shore, by bar migration; but a small amount can be observed along the strand, demonstrably propelled by currents and not by waves. Most of the movement here, however, is caused by wave impact and the reflex flow of water.

The deposition is little affected by currents, for much of it is made upon the outside of Sandy Hook, at a place where the current enters the mouth of False Hook channel, and hence is, if anything, stronger than farther south. But with a constant current deposition often varies with direction and intensity of wind.

It is worthy of note that the point of divergence of the northward and southward currents is so located that the wing, Sandy Hook, is receiving all the waste from the wearing-back of the soft headland of Cretaceous and Tertiary age which extends from Bay Head to Low Moor; while of the transportation along the barrier beaches southward none comes from the headland. Thus these beaches are only carrying their own detritus, piled up at an earlier stage, and are wasting themselves away.

T. A. JAGGAR, JR.,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of April 20th Dr. C. M. Woodward presented the results of a study of certain statistics of school attendance, from which it appeared that the average age of withdrawal from the public schools in three cities compared was as follows: Boston, 15.8; Chicago, 14.6; St. Louis, 13.7.

Prof. J. H. Kinealy exhibited and gave a mathematical discussion of the Stang planimeter, an interesting and simple instrument of Danish invention, but improved in the United States.

WILLIAM TRELEASE,
Recording Secretary.

NEW BOOKS.

A History of the Warfare of Science with Theology in Cristendom. ANDREW D. WHITE. New York, D. Appleton & Co. 1896. Vol. I., pp. xxiii+415; vol. II., pp. xxiii+474. $5.00.

A Dictionary of Chemical Solubilities. ARTHUR MESSINGER COMEY. London and New York, Macmillan & Co. 1896. Pp. xx+515. $5.00.

Current Superstitions. FANNY D. BERGEN. Boston and New York, published for the American Folk-Lore Society by Houghton, Mifflin & Co. 1896. Pp. x+161.

Plane and Solid Geometry. C. A. VAN VELTZER and GEORGE G. SHUTTS. Madison, Wis., Tracy, Gibbs & Co. Pp. viii+395.

SCIENCE

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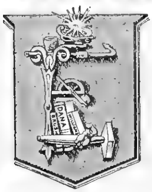

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SCIENCE

Friday, May 8, 1896.

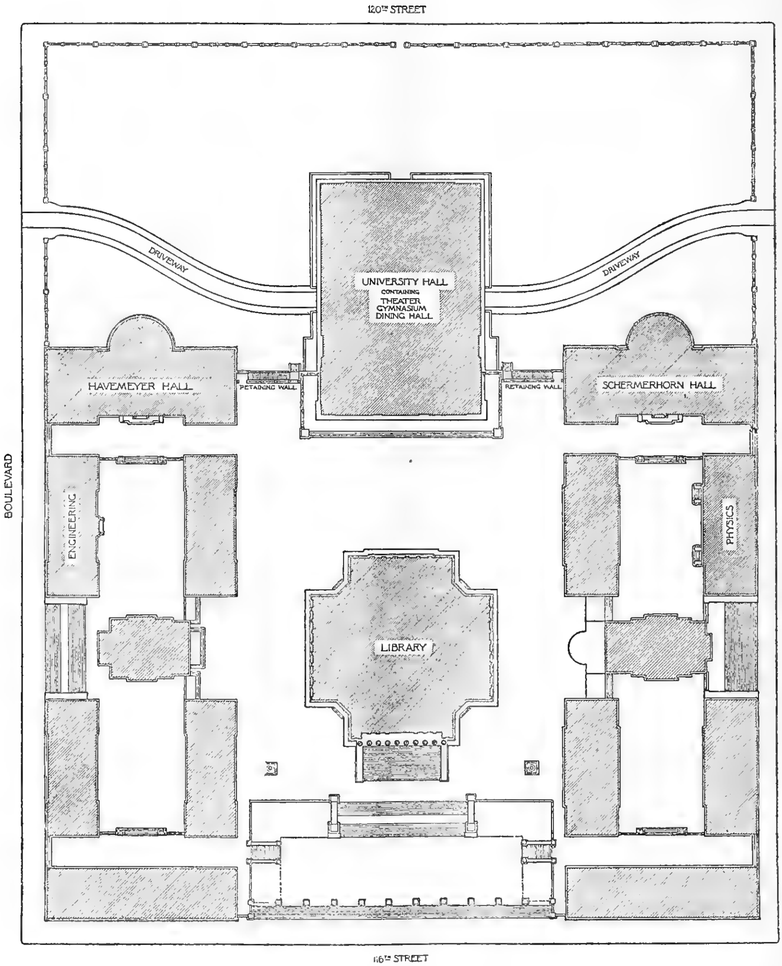
CONTENTS:

THE DEDICATION OF THE NEW SITE OF COLUMBIA UNIVERSITY.

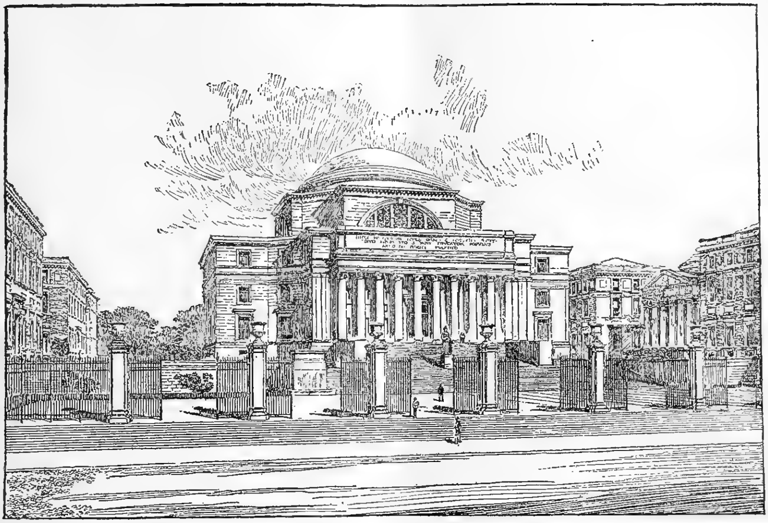
Columbia University has under President Low become a university in name, in externals and in fact, and henceforth takes rank with the great universities of the world.

The new site of the University was dedicated on May the second with ceremonies worthy of its stately buildings in course of erection and of its commanding position above the City of New York. The site of the University, occupying somewhat more than seventeen acres and purchased by the trustees at a cost of $2,000,000, is on the summit of Morningside Heights, between Morningside Park on the one hand and Riverside Park on the other. On the same Heights and adjacent to the University will be the Cathedral of St. John the Divine, St. Luke's Hospital, Grant's Mausoleum and, affiliated with the University, Barnard College and the Teachers' College.

As is shown in the accompanying figures, the Library Building, erected as a memorial of Abiel Abbot Low, by his son, President Low, occupies the central and most elevated position. The basement of Milford granite and the first story of Indiana limestone, already erected, indicate the plan and architectural character of the building. It is classic in style, in the form of a Greek cross, surmounted by a dome. Its width is 192 feet and the height of the dome will be 135 feet.



PLAN OF THE NEW BUILDINGS AND GROUNDS.



THE LIBRARY OF THE UNIVERSITY.

The Library Building, as the other buildings and their arrangement, has been designed by Messrs. McKim, Meade & White, under the immediate supervision of President Low.

In the rear of the Library Building, the basement being on a lower level, will be the University Building, for which the foundations are being prepared. The southerly portion of the building, facing the library quadrangle, is designed as a Memorial Hall. Connecting with the Hall and on the same level will be the University Theater, with a seating capacity of 2,500. There will be a Gymnasium under the Theater, and the engine rooms will be under Memorial Hall. On public occasions the entire building can be used.

Plans have been prepared for Havemeyer Hall, erected as a memorial of Frederick C. Havemeyer for the department of chemistry, and the Engineering Building, and these will soon be in course of erection.

The foundation stones of the Physics Building and of Schermerhorn Hall were laid on May 2. The Physics Building will ultimately be devoted entirely to the department of physics, but for the present will also be used for related sciences. Schermerhorn Hall, the gift of Mr. William C. Schermerhorn, the chairman of the trustees, will be devoted to the natural sciences and will contain the departments of mineralogy, geology, paleontology, botany, zoölogy and psychology. These buildings are to be built of the over-burned brick of a dull-red color, generally known as Harvard brick, and of Indiana limestone. In style they are in keeping with the Library, and represent to some extent a reversion to the best construction of the Colonial period.

To the east and west of the Library will be the Chapel and the Assembly Hall for the use of students, while the other buildings indicated on the plan will be built as required for special purposes.

At noon on May 2d the corner stones of the Physics Building and of Schermerhorn Hall were laid in the presence of the officers and alumni of the University. The corner stone of the Physics Building was laid by Professor Ogden N. Rood, and an address was made by Prof. Howard Van Amringe, who traced the growth of the College, with special reference to its scientific departments, from the time when the first corner stone of the first building of the College was laid, 140 years ago. At that time the teaching force of the institution consisted of the President and one tutor. The speaker called attention to the fact that the first buildings to be built for purposes of instruction and research are for the sciences.

The corner stone of Schermerhorn Hall was laid by Mr. W. C. Schermerhorn, the donor of the building, and an address was made by Prof. Henry F. Osborn, in the course of which he said that the problem of the last twenty years had been the establishment of universities. The problem of the next twenty years is the production of thinkers of the highest type. The building should be laid on the corner stones of breadth, height, energy and repose. Breadth, standing for thoroughness of preparation and wideness of horizon; height, for specialization; energy, for determination in the prosecution of research; and repose, for undisturbed observation, reflection and induction. It is the symmetrical and balanced development of all these factors which will make Schermerhorn Hall a birthplace of discoveries, a permanent monument to its generous founder, worthy of Columbia University, and a new force in American science.

At three o'clock in the afternoon the site was dedicated with impressive ceremonies, held in a large pavilion, in which 3,000 people were seated. In addition to the officers, alumni and students of the University, there were present the Governor of the State, the Mayor of the City, Presidents and representatives of the leading American universities and colleges, and many other distinguished guests.

President Low made the opening address, calling attention to the fact that historic ground would be dedicated to a new use. Already it is twice consecrated. In the Revolutionary War the soil drank the blood of patriots, willingly shed for the independence of the land. Since then, for three generations, it has witnessed the union of science and of brotherly kindness, devoted to the care of those suffering from the most mysterious of all the ills that flesh is heir to. To-day we dedicate it, in the same spirit of loyalty to country and of devotion to the services of mankind, to the inspiring uses of a venerable and historic university. It is no small part of the suitableness of this site for the uses of the University that it here will find itself in the inspiring presence of so many other forces that make for the uplifting of the city. If New York is taunted in the years to come with being a city wholly given up to the love of money, she may well point to this eminence, with its cathedral, its hospital, its educational institutions, its monument to Gen. Grant, and say: "These are my jewels: religion, philanthropy, education, patriotism; these are the things my children care for more than they care for money; therefore I wear these things in my civic crown."

A national flag was then presented to the University by Rear Admiral Meade on behalf of Lafayette Post, Grand Army of the Republic, and a dedication ode in Latin, written by Prof. Peck, was sung.

Hon. Abram S. Hewitt, an alumnus of

the University, made an address reviewing the work of the University in relation to the social and political growth of the city. The last speaker was President Eliot, who, in the name of the universities of America, congratulated Columbia University on its setting commensurate with the worth of its intellectual and spiritual influence.

PSYCHOLOGICAL NOTES UPON SLEIGHT-OF-HAND EXPERTS.

THE determination of the influence of special kinds of occupation and training upon the delicacy, range and quickness of sensory, motor and mental powers is an important and interesting problem. Observations of this kind must first be directed to the determination of the average capabilities of average individuals and then be extended by a study of the influences of age, sex, heredity, training and a multitude of other factors upon the growth and perfection of special powers. Last of all will come the study of small, special groups of persons and of the individual himself. At all times, however, an individual with exceptional powers in any direction is quite certain to attract attention and arouse interest; psychological tests made upon such virtuosi are desirable, even if in individual cases they suggest no very decided conclusions.

Having recently enjoyed visits at my Psychological Laboratory from Messrs. Hermann and Kellar, the widely-known prestidigitators, I put together the results of the series of tests to which they kindly submitted. As the time at my disposal for these tests was limited, I selected such as might be supposed to be related to the processes upon which their dexterity depends, and such as seemed most likely to yield definite results.

Beginning with tests of tactile sensibility, I determined the distance at which two points of an aesthesiometer placed upon the forefinger of the right hand could be recognized as two. This distance was for Mr. Hermann 3.5 mm. and for Kellar 2.5 mm. A comparable average result, obtained from a considerable number of miscellaneous individuals, was about 2 mm., indicating a somewhat coarse sensibility for the two special subjects. The attempt to arrange in their correct order a series of 5 weights increasing by $\frac{1}{15}$ of their weight was unsuccessful in the case of Mr. Hermann, but was successfully carried out by Mr. Kellar. The attempt to arrange weights differing by $\frac{1}{30}$ was entirely unsuccessful for both of them. In a general series of tests, 92% of those tested arranged the former series correctly, and 66% the latter. The weights were estimated by lifting them between thumb and forefinger. A test of sensitiveness to textures was also made. The fingers were passed across a surface composed of wires wound closely side by side. Mr. Kellar was tested with a series in which each surface was $\frac{1}{4}$ coarser than its neighbor, and with one in which the differences were only $\frac{1}{8}$. He arranged the first correctly, but was entirely mistaken in the arrangement of the second. Mr. Hermann tried only the finger differences which he also failed to arrange properly. I next tested the same sensibility by having the subject feel between the thumb and forefinger, as in feeling the thickness of paper, a set of single wires of various calibres, mounted upright on wooden blocks. In one series the differences were $\frac{2}{7}$, in another $\frac{1}{7}$. Both Mr. Hermann and Mr. Kellar succeeded in arranging both series correctly, but this was also done by 9 out of 10 persons who were tested in the same way. Still another form of tactile and motor capacity was tested by requiring the subject to arrange in order a series of bars of varying length by passing the forefinger across them. Both Mr. Hermann and Mr. Kellar passed this test successfully in the series varying by $\frac{2}{15}$ of their average length;

but when the series varied by only $\frac{1}{15}$ Mr. Kellar made one slight mistake, and Mr. Hermann's arrangement was correct. The former task was successfully accomplished by 60% and the latter by 50% of a large group of persons similarly tested.

As both Mr. Hermann and Mr. Kellar have made themselves by persistent training quite ambidextrous, being able to perform sleight-of-hand tricks with either hand (although both are naturally right-handed), it is interesting to record the results of the attempt to move the two hands equally far from a common starting point. For Mr. Hermann, in single excursions, the right hand moved 318, 330, 123, 302, 116, 260 mm.; while the left hand moved 316, 344, 140, 268, 160, 225 mm. The average right-hand movement was 241.5 mm; the average left-hand movement 247 mm. In three cases the left-hand movement was distinctly longer, in one case the right hand was distinctly longer, and in two cases they were nearly alike. The two hands did not move very well together, but there seems to be no constant error in one direction. The average excess of the left hand is 5.5 mm. while the general average for those who have the same tendency is 13.75 mm. It may be added that, in general, about an equal number of persons would have the tendency of moving the left farther than the right as would have the tendency of moving the right hand farther than the left. A similar record for Mr. Kellar was: right hand 281, 357, 404, 155, 108, 313, mm.; left hand 268, 333, 411, 187, 133, 337 mm. This makes an average excess for the left hand of 8.5 mm., the average right hand movement being 270 and left hand 278 mm. Differences of the two hands are nowhere large, the excess of the left hand appearing in four of the six movements. The next test consisted in marking off, by a movement of the arm (the eyes being closed) five equal distances, by raising a pencil from a strip of paper and bringing it down again. The average deviation of these movements from one another was for Mr. Hermann 16.1 % of their average length, for Mr. Kellar 5 % in his first trial and 12.6 % in his second. The general average deviation for this test was 11.8 %.

A few tests of the accuracy of visual perception were made as follows: A line 100 mm. long was to be divided in half. For Mr. Hermann the left half measured 49.75 mm.; for Mr. Kellar in his first attempt 50.75 mm., in his second attempt 52.2 mm. The average error in this test is about 1.75 mm. The same line when divided into three equal parts resulted as follows: For Mr. Hermann, left 33, middle 34, right 33 mm. For Mr. Kellar, in the first attempt, left 35.5, middle 34.5, right 30 mm.; in the second attempt, left 33, middle 35.5, right 31.5 mm. The general average record for this test was, left 32.0, middle 34.5, right 32.7. The subjects were next required to mark off on the three arms of a cross, a distance equal to that (50 mm.) marked off on the upper arm of the cross. The lengths of the arms were unequal and the cross asymmetrically placed on the paper. For Mr. Hermann the left arm was 70.5, right arm 44, lower arm 60.5 mm. This large error can only be accounted for by the confusion of the distance from the center outwards with that from the margin of the paper inwards, but the possibility of such a confusion is not indicative of an accurate observation. Mr. Kellar's result was, in the first attempt, left arm 54.5, right 52.5, lower 50 mm.; second attempt, left 55.5, right 54.5, lower 51 mm. The average results of a large group of individuals in this test were left 54, right 54, lower 61 mm. Mr. Kellar's error for the lower arm is thus less than the average one. Another test of visual perception is called the 'form alphabet.' It consists of 25 characters composed of short and long vertical and horizontal strokes in various combinations. 215 of these are printed upon a sheet in miscellaneous order. A certain one of these is singled out for identification and the subject is required to indicate as many occurrences of this character as he can detect within a limited time (90 seconds). In the first attempt Mr. Hermann did not fully comprehend what was wanted, marking off 10 right and 19 wrong ones. In the second test he marked off 8 correct ones. Mr. Kellar marked off 7 correct ones in the first attempt and 11 in the second. The general average of persons succeed in recognizing about 8 forms in this time.

Quite a number of tests of the quickness of movement and of mental processes were made. For Mr. Hermann the maximum number of movements of the forefinger alone was 72 in 10 seconds, or 7.2 per second, and of the forearm 75, or 7.5 per second. For Mr. Kellar, forefinger 83 in 15 seconds, or 5.5 per second, and for the forearm 127, or 8.2 per second. The average of a large number of individuals for the forefinger movement was 5.4 per second, and of a group of ten persons, tested more nearly in the same way as were Messrs. Hermann and Kellar, 4.8 per second. The average forearm movement of the same ten persons was 7.5 per second. It thus appears that the movements for both Mr. Hermann and Mr. Keller are rapid; Mr. Hermann's forefinger movement being exceptionally so, while Mr. Kellar's forearm movement is the better.

Passing to the ordinary forms of reaction experiments, Mr. Hermann's reaction to a touch upon the right hand was remarkably short, especially for one who had never been a subject for reaction experiments before. The average of 6 trials was 104 σ ($\sigma = \frac{1}{1000}$ second), with an average variation of 11 σ. Mr. Kellar's time was 129 σ, with an average variation of 10 σ. For sound reaction the time was: Hermann 163 σ, variation 32 σ; Kellar 116 σ, variation 25 σ. For visual reaction, Hermann 126 σ, with variation of 26 σ, or omitting one irregular result, 111 σ, with variation of 8 σ; Kellar 125 σ, variation of only 6 σ. For a considerable group of average individuals, reacting for the first time, the following numbers have been found: For touch, 172 σ; sound, 165 σ; sight, 176 σ. It thus appears that both of the special subjects tested react far more quickly than the average individual. Another form of reaction involving manual quickness of movement was arranged as follows: Two keys were placed three feet apart, and the time measured that elapsed between the touching of one and a movement over to and touching the other. Mr. Hermann's time for this reaction was 610 σ, with a variation of 76 σ; Mr. Kellar's time was 299 σ, with a variation of 23 σ. The average of ten individuals making the same test was 364 σ, with an average variation of 32 σ; but these ten individuals show considerable variation amongst one another. Mr. Kellar's time is thus somewhat below the normal, although it is equalled by 6 of the 10 persons tested, while Mr. Hermann's time is unaccountably long. As a type of reaction involving a choice, the distinction of red and blue, associated with movements of the right and left hands, was selected. In this Mr. Hermann's time was 301 σ, with a variation of 64 σ; Mr. Kellar's time, 256 σ, with a variation of 56 σ. For a simpler choice I have an average record of 259 σ, and for the same reaction the average of 10 individuals is 297 σ, with an average variation of 44 σ.

A more complicated reaction involved a movement with any one of the five fingers in response to the appearance of the numbers 1, 2, 3, 4 or 5 behind the opening in a screen. Mr. Hermann's time for such a reaction was 901 σ, with a variation of 200 σ; Mr. Kellar's time being 753 σ, with a variation of 91 σ. The average time of 10 individuals for such a reaction is 588 σ, with a variation of 84 σ. It is thus quite clear that, while the simple reaction time for the two special subjects is much shorter than the normal, their time is just about normal in a reaction involving a simple distinction and choice, and is considerably longer than the normal in a reaction involving a complex distinction and choice.

The incident related of Houdin, the 'king of the conjurers,' regarding his remarkable powers of taking in at a glance the miscellaneous contents of a shop window, suggests another power of great use to the prestidigitator. Mr. Hermann claims to possess a similar power, although he does nothing in his stage performances that demands such a comprehensiveness of perception. I exposed for $\frac{1}{2}$ a second 10 patches of color requiring him to name as many he could see; in each of two trials he named five correctly. When the color patches were different in shape as well as in color he was able to see three in $\frac{1}{2}$ a second and describe them correctly. He was also able to read two words in the same time. I also counted the number of consecutive exposures of $\frac{1}{2}$ second each needed for the reading of a sentence containing 17 words; it required 10 exposures or 1.7 words per exposure. In one-second exposures Mr. Hermann could read 3 isolated words, and required 8 exposures to read a sentence of 29 words or 3.6 words for each exposure.

Similiar averages for a group of about 40 persons indicate about the same quickness of perception for color 4.5 as compared with 5; an inferior perception for combined color and form 1.8 as compared with 3, only 12% of those tested recognizing as many as three color forms; and likewise for words seen separately 1.4 as compared with 2 (22% reading 2 words), but a distinctly higher average of the number of words read in one exposure. On the whole, these few experiments would indicate that, as regards the quickness and scope of perception, Mr. Hermann would rank well (except in reading words in a sentence), but by no means exceptionally well in the general average.

For Mr. Kellar the tests were somewhat differently arranged. The patches of color and the various forms were arranged consecutively and were read in order as one would read words on a line. In exposures of one second Mr. Kellar could read correctly four colors and three forms. In reading words scattered over the page he read 2 correctly in his first trial and 3 in second trial. In four successives exposures of 1 second each he read a sentence containing 27 words, or an average of 6.75 words per second. Mr. Kellar would thus rank below Hermann in all but the reading of words in a sentence, in which he far exceeds him, but would be equalled by about 86% of a group of college students.

Another form of testing this capacity was attempted, but with no success. Mr. Hermann was shown 10 pictures, and asked to study them for about 45 seconds; he was then shown a card containing 40 pictures and requested to mark off which of the 40 were also seen on the former card. He marked off 7, 4 of which were correct and 3 wrong. For Mr. Kellar this test was more systematically made. He was shown a card containing 40 pictures and at the same time a slip containing 10 words, the names of a certain 10 of the pictures; and asked to find the pictures named by the words as rapidly as possible. This took him just 45 seconds, the average of a miscellaneous group of individuals being 64 seconds. A few minutes later he was asked to note on a card containing 60 pictures as many as he could remember having seen on the former card containing 40 pictures. He succeeded in recognizing but 11, the average in this test being 17.5 pictures. I also tested Mr. Kellar's visual memory by having him look at a series of words for about 5 seconds, and then repeat as many as he could in correct order. He succeeded in repeating correctly 5 out of a series of 6 words, and 6 out of 9 words. For a similar series of numbers his memory was much better. He could repeat 7 numerals correctly, and in attempting to repeat a set of 10 made but 2 errors. This is better than the average, but not remarkably so. It should be added that several very striking performances are given by Mr. Kellar in which memory forms a considerable part. It is, however, a very special form of memory, involving the formation of accurate associations and classifications rather than an extended series of impressions.

If we now select those tests in which the records of Mr. Hermann and Mr. Kellar differ markedly from the normal we find as follows: In the quickness of response to a touch and a visual stimulus both the special subjects, and Mr. Kellar as well in response to an auditory stimulus, excel to a considerable extent the average individual. But this quickness of reaction does not appear in the more complicated reactions; and in the most complicated reaction they both fall considerably below the normal. In the quickness of movement we find decided indications of an unusual quickness for both Mr. Hermann and Mr. Kellar. In the scope and accuracy of visual perception we find in part a good record, but on the whole no very decided excellence appears. In tests involving mainly tactual perception and muscular perception, the indication is rather that they are below than above the normal. I might also add that I have repeated a few of these tests upon a local sleight-of-hand performer, and find for him a good record and particularly a great quickness of movement. This is perhaps to be explained by his facility in musical execution as a pianist and organist as well as in sleight-of-hand performance.

The positive results of the investigation are thus small, but as far as they go they are consistent with the forms of dexterity that are utilized in sleight-of-hand performances. They also indicate that it may well be that special skill in one very specialized form of training may be only slightly influential upon other forms of capacity. So little is known of the correlation of powers of this kind, and small series of tests are so apt to be affected by accidental errors, that any suggestions which the data seem to warrant must be put forward with great caution. The individual is interesting, but the methods of research are, and must be, particularly adapted to statistical groups.*

JOSEPH JASTROW.
UNIVERSITY OF WISCONSIN.

THE INFLUENCE OF CARBON DIOXIDE ON THE PROTOPLASM OF LIVING PLANT CELLS.

THE history of investigation of the relations of plants to the component gases of atmospheric air and with special reference to CO_2 may be said to begin with the researches of Priestley and Ingenhousz (1779). Among the results obtained by the latter was the fact that plants die in 'air' fatal to animals, and that such air contained large portions of CO_2. De Saussure next made his famous tests of the effects of the atmospheres containing various proportions of CO_2 upon growth (1804), and John found that peas would not germinate in an atmosphere of this gas, and since the seeds were killed by the alcoholic fermentation accom-

* I feel that it is necessary to add that Mr. Hermann perhaps did not do himself justice in some of the tests. He was always quick, confident and decided in his judgments, often performing a test in half the time taken by the average person. He was much interested in the tests, but seemed confident of his ability to do what was required, with little effort. It may well be that with a little more deliberation, and an opportunity of even a brief familiarity with the tests, better results could have been secured.

panying the experiments he concluded that the gas was poisonous to plants (1810). About this time Davy obtained some results confirmatory of those previously attained by De Saussure.

No further important facts were brought out until forty years later when, in the period of activity following the discovery of protoplasm, its relation to carbon dioxide were taken up by Kabsch, in a study of its influence on 'sensitive' plants (Bot. Ztg., 1862). The field attracted many workers of the first rank among whom are Kühne, Boussingault, Pfeffer, Schützenberger, Godlewski, de Vries and Boehm, who paid chief attention to the influence of the gas in varying pressure and proportion upon the synthetic activity of chlorophyll-bearing plants. The discovery of Pasteur that certain forms of Saccharomycetes and Schizomycetes might live in a medium devoid of oxygen, was followed by the experiments of Frankel, in which he found that many forms of these groups might live in an atmosphere of pure CO_2, and that the relations of each form to the gas was entirely specific (1889). D'Arsonval, pursuing similar lines of experiments, met no organism capable of continued existence in this gas at high pressures, forty-five atmospheres (1891). Frankland obtained results entirely in harmony with those of Frankel and further found not only great specific differences in resistence to the gas, but also wide differerences in individuals from the same colony (1889). Demoor in some recent work upon the subject in connection with the effects of many different gases reaches the conclusion that the activity of the plasma is possible only in the presence of oxygen, while the nucleus may not be affected by conditions which inhibit the action of the plasma.* Perhaps the most extensive and exact series of experiments dealing with the relations of CO_2 to protoplasm devoid of chlorophyll is that recently carried out by Lopriori at Berlin.* This writer used gas obtained by heating potassium bicarbonate, according to the method of Schloesing and Laurent, which was stored in gasometers of special design, and the integrity of all mixtures was confirmed by numerous analyses. The microscopal examination was made in chambers similar in principle to that of Engelmann. Among his more important results are those which concern the accommodation of protoplasm to the unusual proportions of the gas and the germination of spores under such conditions. The streaming movement in the stamen hairs of Tradescantia was inhibited by exposure to a mixture of 20 parts oxygen and 80 parts CO_2 for 3 or 4 minutes, and was resumed after a minute's exposure to the air. A second exposure to the same mixture a half hour later had no effect on the movement, and a much greater proportion of CO_2 was now necessary to influence the rate of movement. By immersion of the hair in successive mixtures of the following composition:

1.	O 25 parts	CO_2	75 parts	
2.	" 20	"	" 80	"
3.	" 10	"	" 90	"
4.	"		" 100	"

it was possible to maintain the movement in the pure gas.

The germination of spores of Mucromucedo was totally inhibited in pure CO_2 and delayed a varying length of time in mixtures containing high proportions. The myceliæ formed in mixtures containing above 10–30 parts of CO_2 did not develop sporangia. In such instances the protoplasm became highly vacuolar, while globular swellings were formed on the myceliæ sim-

*Arch. d. Biol., 13: 163. 1894.

* Ueber die Einwirkung der Kohlensäure auf das Protoplasma der lebenden Pflanzenzelle. Jahrb. f. wiss. Bot. 28: Hft. 4. 531–625. 3 Figs. 2 Pls 1894.

ilar to those resulting from the use of concentrated nutritive solutions. If such structures were brought into atmospheric air vegetative myceliæ were formed. Spores which had been immersed in pure CO_2 for three months germinated in the usual manner. In confirmation of Brefeld's work, Lopriore finds that Saccharomyces will not grow in pure CO_2, although but one-six thousandth part of oxygen is necessary as has been found by Brefeld. After 12 hours' immersion in the pure gas growth was resumed upon access of atmospheric air. Mixtures containing large proportions of CO_2 exerted a much stronger adverse influence upon Mycoderma cerevisiæ, which was killed by twelve hours' exposure to the pure gas.

Pollen grains reacted to mixtures in the most varied manner. Some formed protuberances in the pure gas, and then burst; in others no change was visible, while in others disintegration shortly ensued. Tubes formed in air and exposed to pure CO_2 were generally quickly destroyed. Proportions of 1 to 10 parts of CO_2 promoted the growth of the tubes, but did not increase the turgidity, which, however, was markedly increased if afterward brought into ordinary air. It will be remembered that in pollen tubes growth-extension of the walls is practically independent of turgidity. In many instances important changes in the plastic and elastic extensibility of the cell wall were induced, in a manner similar to the effects of strong oxygen solutions.

The results of Lopriore's work point to the conclusion that CO_2 exercises a retarding influence upon the activity of protoplasm, while directly exposed to it, but has no permanently injurious effect. Different plant cells exhibit widely divergent reactions to the gas. It appears quite well established that animal protoplasm is affected much more strongly by increased proportions of the gas. The influence of the gas upon the protoplasm of plant cells is characteristic, and its effects do not result from the simple exclusion of oxygen; its action is upon the nutritive processes, and since the widest disproportion exists between the volume and the effect produced, if it exercises any stimulating influence the reaction must be so limited as to be easily obscured.

The establishment of the fact that CO_2 exercises a positive influence upon protoplasm makes necessary a revision of some of the conclusions reached concerning ærobic and anærobic organisms, and particularly the researches of Correns (*Flora*, 1892) upon the relations of plants to oxygen, in which oxygen was partly or entirely displaced by CO_2. The anomalous reactions of tendrils obtained by this author seem to be capable of explanation in view of the recently discovered relations of the gas to plant protoplasm.

D. T. MACDOUGAL.

THE STATE UNIVERSITY OF MINNESOTA.

NOTES ON CERTAIN UNDESCRIBED CLAY OCCURRENCES IN MISSOURI.

THE geologically well-known clays of the State of Missouri (which are very abundant and widely known, commercially), occur in the Quaternary—chiefly confined to the loess deposits along the larger rivers; in the Tertiary—in the southeastern part of the State; and in the Coal Measure formations —in the extension of the Iowa Coal Basin southwestwardly, and also in the small outlier of the Illinois Coal Basin, which is confined, practically, to St. Louis city and county.

Another interesting and commercially valuable group of clays, which has, apparently, never been described, includes a large number of more or less isolated pockets of fire clay and 'kaolin,' occurring unconformably in cavities and former valleys among the Silurian and, possibly, in some Devonian and Lower Carboniferous rocks. These pockets of clay are distributed over a number of counties ranging, inclusively, from St. Charles, Warren, Montgomery and Callaway counties (which lie west of St. Louis), on the north; through Jefferson, Franklin, Gasconade, Osage and Maries, to Crawford, Phelps and possibly other counties on the south, the whole area occupying about the center of the eastern half of the State, its northern boundary being but a few miles north of the Missouri river.

These clays are of uncertain geological age. The beds of clay as they now occur are probably the last remnants of a once very extensive formation in this region. They are to be found mostly in the minor lateral valleys along the borders of the greater ones, and apparently always near the tops of the valley sides. They sometimes occur in shallow pockets along the tops of the divides, this being especially noticeable in Gasconade county, where these clays occur over a wide area. The greatest thickness of this clay seen by the writer, was at Regina, Jefferson county, where a pocket had been opened to a depth of sixty feet. Borings have been made in pockets which seem to belong to this class, which penetrated the clay to a depth of one hundred and twenty-five feet. In all of the many pits of this sort observed the contact between the clay and the surrounding sandstones or limestones was sharply unconformable, and indicated the origin above suggested.

The clay is usually cream-color, but is often mottled with purple and reddish tints, which are organic stains and readily disappear on ignition. It is mostly hard and brittle, breaks with a conchoidal fracture, and weathers concentrically, breaking up indefinitely into sharp, angular fragments. It is mined (as a fire-clay) mostly in Montgomery, Warren, Franklin, Crawford, Gasconade and Phelps counties, for shipment only, going to fire-brick works in St. Louis, Chicago and Eastern cities, where it is used in connection with more plastic clays to diminish their shrinkage.

In one locality near Union, in Franklin county, the upper four or five feet of this clay is plastic. Another variety occurring in many places is white, brilliantly mottled with reddish tints, and sometimes stained very dark purple; is comparatively soft and free from sand; has a smooth, soapy feel and is cut with a knife in an extremely smooth, soft way.

These three phases, the hard fire-clay, the plastic clay, and the last-mentioned variety —called locally 'kaolin'—may represent different horizons in this group of clays, and it is probable that the variety called 'kaolin' is part of the same formation which is found southeast of this region, where it has been considered a true kaolin, occurring in the place of its origin among the parent crystalline rocks.

The only trace of organic remains found in this group by the writer was taken from the clay pit of Isidor Mandle, in Regina, Jefferson county (where the clay is worked and shipped east to porcelain factories). This specimen consisted of a piece of beautifully carbonized wood, nearly two feet in length, and five inches by three inches, in cross section, at its larger end, whence it tapered towards the other end to about half that size. A piece of this wood was sent to Prof. F. H. Knowlton at the Smithsonian Institution, who prepared sections of it for microscopic examination and kindly furnished the writer with the following information in regard to it, which is given in his own words:

"The structure is very finely preserved and comes out beautifully. It belongs to the genus Dadoxylon, and is very close to Dadoxylon Beinertianum Endl., from the Sub-carboniferous Falkenburg in Silesia. The wood cells have one, or more often two, alternating rows bordered with oblong cells or inner pores, those on the opposite sides being placed at right angles, thus producing a kind of maltese cross within each circle. This is very characteristic of the Palæozoic genus Dadoxylon, and your material cannot by any means have come from the Tertiary unless it has been redeposited. The specimen itself is Palæozoic, and the question of its possible removal from its original position is, of course, one of stratigraphy."

GEO. E. LADD.

ATLANTA, GA.

NOTE ON A BREATHING GAS WELL.

A VERY remarkable gas well recently came under the writer's observation while engaged in studying the geology of the Santa Lucia Range. It is situated on the Eagle Ranch, on the eastern side of the Range in San Luis Obispo county, California.

The well is interesting on account of two things: (1), the presence of gas in the Golden Gate series, it being encountered while boring for water; and (2), the intermittent flow of gas, the periods of flow alternating with those of drawing in air.

The geology of this portion of the range is quite complicated. In the vicinity of the Eagle Ranch there are four different formations; the oldest, the Golden Gate series, consisting of shale, sandstone and jasper, with numerous ancient eruptives, the whole being probably of Upper Jurassic age. The rocks of this series are extensively developed through the Coast Ranges of California, but have never before been found to contain gas, nor have any indications of coal or oil been met with.

The well was bored on the point of a hill rising perhaps seventy-feet above a little flat on which the ranch buildings are situated; this flat is underlaid by Lower Cretaceous shales which surround the hill on three sides. The Chico sandstone occurs, overlying the shales in various places; while to the east, some distance away, the Bituminous Slate series (Miocene) is met with filling the Salinas Valley. The Miocene is preëminently the oil and gas bearing formation of California. The writer does not know of any locality in the State where gas is obtained in quantities sufficient for use from beds of Cretaceous age, although such may be the case.

The well under consideration has a bore of six inches and was put down to a depth of three hundred and fifty-six feet. The strata passed through consists of shale and sandstone having a very steep dip. They are exposed on the south side of the hill at a distance of a little more than a hundred feet from the well, and exhibit the intense distortion of and shearing so characteristic of the Golden Gate series. When first bored, the water rose to within about eighty-five feet of the surface. A small amount of gas was encountered at a depth of ninety feet. Comparatively little gas came from the well at first, but during a stormy spell the well was pumped continuously for some time, and as the water grew lower a noticeable amount of gas began to issue. This increased until it was estimated to amount to twenty thousand feet per day. This state of things lasted for about six weeks, when the volume began to decrease, finally becoming intermittent. The well has now been opened for four years, the gas continuing to average about 250 feet per day. During settled weather the intermittent action is fairly regular, the gas issuing for about three hours, when an equilibrium being reached, the current changes and air is sucked in for the same length of time. If the air is not allowed to enter the gas will not flow; consequently an automatic valve has been placed at the surface of the well, permitting the ingress of the air. The suction is frequently so strong that, if only a small opening is left a roaring sound is produced, which is audible at the ranch house.

The gas issues also with a strong pressure. The amount of water in the well does not affect the flow of gas in any manner.

Whatever the cause of the intermittent action it is influenced by the varying pressure of the air, for before a storm, when the barometer is falling, the gas continues to issue for a much longer period, sometimes for 24 hours; and when the rise in the barometer takes place there is the same prolongation of the period of inhalation. During high barometric conditions the equilibrium may continue for some time. The well at the present time produces four to five thousand gallons of water per month, being pumped on an average about every two weeks. The locality is about twelve miles from the sea in a direct line, and has an elevation of 1,300 feet, so that it would seem impossible that tidal action could have anything to do with the phenomenon. During a talk with Mr. Benton, the superintendent of the ranch, who has closely watched the well, he stated that he had noticed no connection between the respiration and any physical conditions save the one referred to. The gas is used in all the ranch buildings, but is of such a character that with the ordinary burner it does not give a good light, consequently an incandescent burner is used.

The question of the source of the gas is rather a puzzling one. It hardly seems possible that it can be derived from the strata penetrated, and if not it must have its source in the surrounding Cretaceous shales, or possibly in the white Miocene shales, which here, as nearly everywhere else, are filled with animal remains. A well was sunk to a depth of 900 feet in the same area of Cretaceous shales about two miles miles to the west, but without encountering water or gas. If derived from the Miocene shales the gas must circulate through the rock for nearly three-fourths of a mile at least. The water is very pure, containing no alkali or trace of oil such as might be expected if it has passed through Miocene strata.

As to the cause of the intermittent action no reasonable explanation has occurred to the writer, and it is left for physicists to explain. It is certainly not due to any of the connections on the surface, for the facts stated were observed prior to such connections. HAROLD W. FAIRBANKS.

BERKELEY, CALIFORNIA.

SOURCE OF X-RAYS.

NOTWITHSTANDING the considerable amount of attention the subject of Röntgen's discovery has received, there is a very wide diversity of opinion concerning the part of the vacuum tube at which they are produced. In view of the high reputation of the authorities who have expressed their decided opinions on this subject as experimenters and observers, it would be rash to advance the statements here made as being opposed to their own views. It is unquestionably true, however, that the evidence here given must be considered as demonstrating that *in this form of vacuum tube the X-rays radiate in all directions from the surface first encountered by the cathode rays*, and that they do not start from the anode.

Fig. 1 represents the vacuum tube. It is made of German glass tubing, 4 cm. in diameter and 8 cm. long. One end is drawn out, and an aluminum electrode terminating in a disc is inserted at A. A second is inserted in the side, at C, and is enclosed in a thick piece of glass tubing, to prevent any radiations from it reaching either A or B.

The end B has a flange which is ground to receive a ground plate of aluminum B. This plate is 3 mm. thick, except at the center, where it is ground away to a thickness of about one-tenth of a millimeter. The joint was made by melting shellac (containing a small quantity of rubber) around

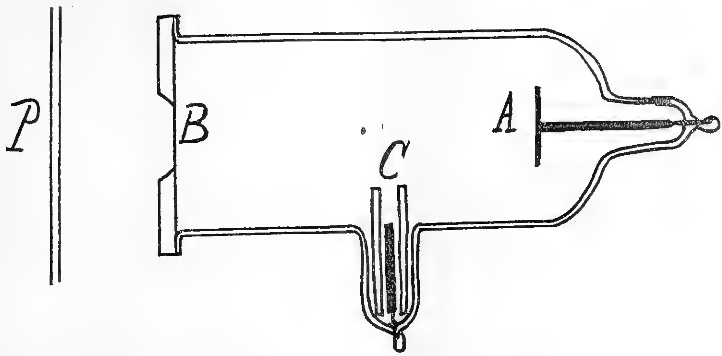


FIG. 1.

the outside. This joint was found to hold so well that the discharge frequently passed through the air (about 5 cm.) outside the tube.

A photographic plate in its plateholder was placed at P, about two centimeters from the aluminum plate B. The experiments were as follows:

1. A was made the cathode and B the anode. The resulting photograph is given in Fig. 2. It shows that the X-rays radiate in all directions from the thin portion of the B.

2. B was made the cathode and A the anode. The resulting photograph is given in Fig. 3. It shows that the X-rays radiate

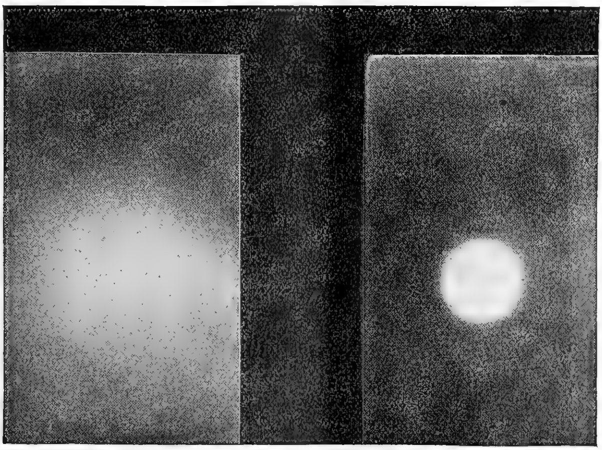


FIG. 2. FIG. 3.

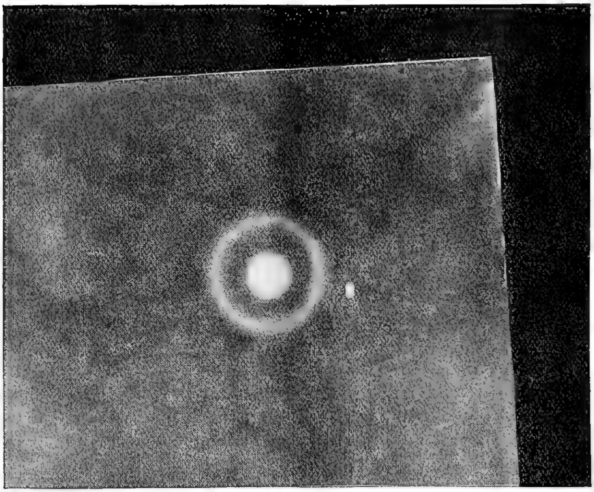


Fig. 4.

from A and cast a shadow, moderately well defined, of the plate B.

3. B was made the cathode and C the anode. An iron washer was placed in contact with the thin aluminum window at B. The resulting photograph is given in Fig. 4. it shows that the X-rays radiate from A exactly as in (2), casting a shadow of the aluminum disc and the iron washer in front of it.

Now, while it is possible to explain experiments (1) and (2) by considering that the X-rays radiate from the *anode*, no such explanation will account for experiment 3, in which the undoubted source (A) was unconnected with either terminal of the secondary coil which furnished the discharge.

On the other hand, not only are all three experiments consistent with the statement given above, but the origin of the X-rays at the place where fluorescence is excited on the glass walls of the common form of Crooks tube is also thereby accounted for.

While it may be true that the effects may be enhanced by making the anode the first object encountered by the cathode rays, the result of these experiments is to show that the anode does not play an important rôle in the phenomenon.

A. A. Michelson,
S. W. Stratton.

CURRENT STUDIES IN EXPERIMENTAL GEOLOGY.

THE COLOR OF WATER, AS AFFECTED BY CONVECTIONAL CURRENTS.

Prof. W. Spring, of Liège, has just added a new and interesting contribution* to our knowledge of the causes of illumination of deep waters. Pure water is actually blue when seen through sufficient thickness. Spring showed in 1883 that perfectly colorless particles in suspension would form a turbid medium, giving passage to

* Arch. des Sciences phys. et nat. Geneva, March, 1896.

the red and yellow rays, but reflecting the rays of shorter wave-length, *i. e.*, the blue and violet. Hence, light reaching the observer by *transmission* appears greenish, the original blue of the water being added to the transmitted orange rays. The blue of reflection is largely absorbed, or but slightly augments the color of the water. Blue water should contain no turbid elements, but deep water absolutely free from turbidity should absorb all rays and appear black. Contrary to this, the Mediterranean and the Lake of Geneva in their deeper portions are intensely blue. Hence, even the most limpid waters are not optically void. Tyndall and Soret believed that even the purest water might contain particles in suspension which account for the *illumination* of the blue waters in nature. This is contradicted by the evidence from experiments with polarized light, and by the fact of the absorption of the rays of minimum wave-length by a turbid medium.

As a further test, however, Prof. Spring has prepared an elaborate apparatus to prove whether loss of illumination by absorption through a great thickness of water be accompanied by a loss of *transparency* due to the presence of particles in suspension, as in the case of the atmosphere. A tube of glass was constructed, 26 meters long and of 15 mm. internal diameter, mounted at a slight inclination on a scaffold and straightened with hand vises until its axis coincided with the optical axis of a telescope adjusted at one end. Heavy black paper covered the tube throughout its length, and the ends were sealed with glass plates, the one nearer to the source of light bearing 'cross-hairs.' Glass tubes were fitted at each end for the introduction of the water, which was distilled with the utmost care in platinum retorts. Either daylight or the Auer incandescent burner could be used as illuminants.

A column of water 26 m. long appeared deep blue; with the illumination of the Auer lamp, the telescope revealed the cross-hairs *as sharply defined* as though the tube were empty; hence the presence of foreign particles is improbable. Small apertures pierced in the paper wall of the tube gave evidence of emission of light laterally only at a distance of 2 meters from the lamp. This suggested some influence of the heat rays; to test this, water 12° C. warmer than the tube was introduced and produced complete opacity, which gradually passed off as the water regained the normal temperature. The minimum difference of mean temperature which would produce opacity was determined to be only 0.57° C.

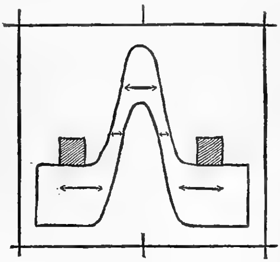
A shorter tube 6 m. long was constructed of metal with a view to testing the local application of heat. On applying a flame at one point in the side of the tube, the sharply defined opening at the farther end appeared to enlarge, became blurred and finally disappeared, leaving an evenly illumined field. The effect suggested a cloud passing before the sun. Continued application of heat produced complete darkness.

These experiments show that bodies of water are not optically homogeneous when traversed by convectional currents, even though the latter are caused by very slight differences in temperature: the warmer portions have the properties of a turbid medium. Hence less absorption and greater emission of light, making apparent the blue color of the water. Cooling increases transparency, hence the differences of color produced by the cooling shadow on the water's surface, of a cloud or a mountain; a dry wind, cooling the water's surface by increased evaporation, will at the same time increase its transparency. Conformable to this explanation is the fact stated by Forel, that fresh water lakes are more transparent in winter than in summer. The facts described are not held by the author to preclude the operation of other agencies, for doubtless the illumination and color of water are frequently due to combined causes.

THE PLASTICITY OF ICE CRYSTALS.

DR. O. MÜGGE has recently published the account* of a series of experiments on he deformation of ice relative to its crystalline structure. McConnel's experiments have shown that permanent deformation by *bending* may be induced in an ice slab only when the pressure acts in the direction of the optic axis; the optic axis remains normal to the curved basal surface after bending.

Mügge shows that plastic translation without bending is possible only in a plane perpendicular to the optic axis. To the middle of a small bar of ice placed across two supports, the latter as near together as possible, a heavy weight was attached by a strap. The optic axis lay horizontal. A portion of the ice, about as wide as the strap, was gradually drawn down until completely detached. (See figure.) The temperature remained below freezing. The stretched portions were optically oriented exactly like the main bar, the axis lying everywhere horizontal as indicated by the arrows.



The plane of the base was determined to be the only plane in which such translation could be induced; pressure oblique to a basal slab was found to produce torsion that tended to bring the optic axis into coincidence with the direction of pressure.

These experiments prove that plastic deformation and flexibility are important components of the movement of glaciers. The parallel position of the optic axes of associated 'Körner,' or glacial granules, has been observed, at least locally; this is undoubtedly due to the fact that by translation on planes parallel to the base and simultaneous bending, the optic axis is forced into parallelism with the direction of pressure. Observations on plates of ice cut from the Aletsch Glacier show that where its bed sharply slopes, the optic axis lies at right angles to the lower surface of the ice. It is probable also that the increased purity of the ice at a glacier's lower extremity is due to the gradual liberation of 'air bubbles' in migration along definite planes.

T. A. JAGGAR, JR.

CAMBRIDGE, MASS.

*Neues Jahrbuch für Min., Geol. und Pal., 1895, Bd. II., Heft 3, p. 212.

NOTES UPON AGRICULTURE AND HORTICULTURE.

THE POTATO SCAB.

SEVERAL Experiment Stations are making tests of various remedies for the potato scab. This trouble of the potato is due to a fungus closely related to the bacteria.

Bulletin No. 33 of the Rhode Island Station gives a somewhat lengthy report of experiments that cover three years with various chemicals. Dr. Wheeler and Mr. Tucker, the authors, state that air slaked lime, wood ashes and calcium carbonate, calcium acetate and oxalate all increase the scab; while calcium chloride prevents it, but likewise injures the potato plant. Calcium sulphate (land plaster) is the only form of lime not harmful to the potato which fails to increase the scab. Common salt reduces the amount of scab, and this explains why sea weed is healthful to potato land when used for manure. Barnyard manure increases the scab, probably because alkaline. On the other hand, oxalic acid tends to reduce the scab. It is thought that anything which reduces the acidity of the soil will increase the scab. The scab fungus seems to multiply in the soil when the potato crop is not present. Upon acid soils practical immunity from scab has been secured for three years. Upon acid land potatoes free from scab may be grown if no barnyard manure is used.

CHERRIES.

Under the above short title Prof. Bailey and Mr. Powell have prepared a bulletin (No. 98 Cornell University Experiment Station), giving among other things the classification of cherries under the horticultural groups ; namely sours, amarelles and morellos, sweets, mazzards, hearts, begarreaus and dukes, and then the botanical grouping. There are two species, namely, *Prunus cerasus* L., the sour cherries, and *P. avium* L., the sweet cherries, with three well-marked varieties under the latter species.

Cherry growing is a neglected industry. The tree likes a rich loamy soil with frequent cultivation. The worst enemy is the curculio, and jarring the trees will save many cherries. For the rot spraying with Bordeaux is recommended. The bulletin is illustrated with several engravings of fruits made from photographs of subjects natural size.

CURRANTS.

New York State can boast of two Experiment Stations, one, the older, at Geneva, and the other at Ithaca. Both have their number of issues in the nineties, while, for example, No. 98 of the Cornell University Station is upon cherries, briefly mentioned in the previous paragraph, the No. 95 of the New York Station deals with currants. Prof. Beach, in this, informs the readers that the testing of varieties of currants began at Geneva in 1882 with eleven sorts. Now there are forty under study and this exclusive of seedlings. It is shown that of the red sorts the Prince Albert is the largest bearer, it averaging nearly nine pounds per plant. The White Dutch is the most productive of the white sorts. But it seems from the bulletin that quantity is not everything, for healthfulness of bush, shipping quality and flavor of the berry must all be considered. One sort may be too watery for profitable jelly making or have a skin too thick for jam, etc. The reader of these bulletins upon fruits is led to imagine that the stationists practice all the phases of the culinary art in order to pass judgment upon their subjects.

Byron D. Halsted.

New Brunswick, N. J.

CURRENT NOTES ON ANTHROPOLOGY.

SOUTH AMERICAN LINGUISTICS.

Dr. Rodolfo Lenz continues his valuable contributions to the study of the Araucanian stock by the publication of a series of dialogues in the Picunche dialect. His presentation and analysis are fully up to the requirements of modern scientific linguistics. His article appears in the 91st volume of the 'Anales de la Universidad de Chile.'

The tireless student of the Argentinian languages, Samuel A. Lafone Quevedo, publishes in the 16th volume of the 'Boletin del Instituto Geographico Argentino' an essay of over forty pages on the Vilela or Chulupi language of the Chaco. His material is mainly from the works of Hervas, Adelung and Pelleschi. The results he reaches confirm the statement of affinities between the Lule and Vilela tongues which I advanced in my 'American Race,' p. 313 (1891). That these related dialects should be classed with the Pacific or Andean tongues on account of their suffix formations and personal pronouns, is not yet sufficiently demonstrated.

The journal 'Languages' (published in London) stated in June last that the British consul in Bolivia had discovered some hitherto unknown native idioms in that country; but no further information about them has appeared.

THE DIMINUTION OF NATALITY.

This subject occupied a prominent place in the discussion of the anthropological section of the French Association for the Advancement of Science at its last meeting. More than elsewhere, it deserves attention from the scientists of that nation, for out of the 86 departments into which France is divided, in 51 the deaths exceed the births. The annual natality for the whole country is only 23.7 for each 1,000 inhabitants, and this number includes the still-born!

To remedy this progressive depopulation, its causes must be ascertained. Dr. E. Maurel brought forward an interesting theory. He pointed out that the birth rate is lowest in those departments where food is most abundant and cheapest. The relation between these two facts he held to be the prevalence of hereditary arthritic diathesis (uric acid diathesis), leading to diminution of reproductive vigor in both sexes, this diathesis arising from excessive alimentation. Another speaker, Dr. Pommerol, attributed the diminished natality to voluntary restriction, while others suggested the increase of religious celibacy, the laws relating to the division of property, the lateness of marriages, and the decreased reproductiveness of women.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

VIVISECTION IN THE DISTRICT OF COLUMBIA.

During the recent session of the National Academy of Sciences a report was prepared with reference to the proposed legislation interfering with the practice of vivisection in the District of Columbia. The report states that physiology must be studied by experimental methods. The physiologist, no less than the physicist and the chemist, can expect the advancement of his science only as the result of carefully planned laboratory work. If this work is interfered with medical science will continue to advance by means of experiment, for no legislation can affect the position of physiology as an experimental science. But there will be this important difference: The experimenters will be medical practitioners and the victims human beings. That animals must suffer and die for the benefit of mankind is a law of nature, from which we cannot escape if we would. But the suffering incidental to biological investigations is trifling in amount and far less than that which is associated with most other uses which man makes of the lower animals for purposes of business or pleasure. The men engaged in the study of physiology are actuated by motives no less humane than those which guide the persons who desire to restrict their action, while of the value of any given experiment and the amount of suffering which it involves they are, owing to their special training, much better able to judge. When the men to whom the government has intrusted the care of its higher institutions of research shall show themselves incapable of administering them in the interest of science and humanity, then, and not till then, will it be necessary to invoke the authority of the national legislature.

RADIATION FROM URANIUM SALTS.

In an important artiticle in *Nature* (Apr. 23), Prof. J. J. Thomson states that the investigations of M. Henri Becquerel on the radiation emitted by certain salts of uranium have shown the existence of a kind of radiation intermediate in its properties between light and the Röntgen rays. These investigations are exceedingly interesting on account of the differences as well as the analogies they disclose between the uranium radiation and the Röntgen rays. M. Becquerel has shown that the radiation from the double sulphate of uranyle and potassium is analogous to Röntgen rays, inasmuch as it can affect a photographic plate after penetrating substances such as aluminium, copper, wood, etc., which are opaque to ordinary light; it also resembles these rays in being able to discharge an electrified body, whether the charge be positive or negative. On the other hand, it differs from Röntgen rays and resembles ordinary light, inasmuch as it can be refracted and polarized. It is also much more easily reflected than Röntgen rays. The radiation from the uranium salts is thus intermediate in properties between ordinary light and Röntgen rays; and as there can be no question but that this radiation consists of transverse vibrations, inasmuch as it can be polarized, it affords strong presumptive evidence that the Röntgen rays are also due to transverse vibrations.

The persistence of the radiation from the potassium uranyle sulphate is very remarkable. M. Becquerel found that crystals which had been kept in the dark for 160 hours continued to radiate vigorously. This radiation is absorbed almost equally by aluminium and copper, so that it does not show the same dependence upon the atomic weight of the absorbing medium as that of the Röntgen rays; on the other hand, the radiation resembles Röntgen rays in not being homogeneous.

GENERAL.

THE Council of the American Association for the Advancement of Science at the Springfield meeting instructed the sectional committees hereafter to prepare a programme for their sectional meetings and transmit the same to the Permanent Secretary at least one month before the annual meeting. The Buffalo meeting opens on Monday, August 24th, and titles and abstracts of papers should be sent by members to the Secretaries of the sections at as early a date as is convenient.

THE German Society of Naturalists and Physicians will meet at Frankfort-on-Main from the twenty-first to the twenty-sixth of September.

WITH the last issue of the Proceedings of the Royal Society an index slip is issued giving the details needed for an author and subject catalogue of the contents. In the case of one paper there are as many as eleven entries for the subject catalogue. The index slip is printed on one side of thin paper so that the entries can be conveniently attached to cards.

The Physical Review for May–June will contain articles on 'Solids and Vapors,' by Wilder D. Bancroft; 'On the Heat Effect of Mixing Liquids,' by C. E. Linebarger; 'The Influence of Heat, of the Electric Current, and of Magnetism upon Young's Modulus,' by Mary Chilton Noyes,' and 'A Photographic Study of Arc Spectra,' by Caroline W. Baldwin.

THE prize founded by M. and Mme. Victor Saint Paul for the discovery of a remedy for diphtheria will be divided by the French Academy of Medicine and has been divided between Dr. Roux and Prof. Behring.

IT is unofficially announced that the local committee in charge of the International Medical Congress to be held at Moscow this year has reversed its decision to exclude English from the languages to be used.

LONGMANS, GREEN & CO. have issued a reprint of Tyndall's *Glaciers of the Alps*.

THE Metric System is being actively discussed by correspondents in the London *Times*. Those opposing the Metric System seem to be in the majority, but the arguments used seem to be mostly trivial or absurd.

GOV. MORTON has nominated Charles A. Weiting, of Cobleskill, N. Y., to succeed Frederick C. Schraub as New York State Commissioner of Agriculture.

PROF. H. LANDES, of the State University of Washington, has been appointed State Geologist.

THE semi-annual meeting of the American Antiquarian Society was held in Boston on April 29th. Among the papers presented was one by Rev. Stephen D. Peet on the history of archæological explorations in the Mississippi Valley. Prof. J. W. White, of Harvard University, was elected President.

IT is reported in the *British Medical Journal* that those working with the X-rays are likely to suffer from a variety of skin affections said to be similar to the results of sunburn.

THE London *Times* states that a recent sale of birds' eggs included a specimen of the egg of the great auk (*alca impennis*). This specimen, except for a small fracture on one side, is in good preservation. It was purchased in 1841 from Mr. Hugh Reid, of Doncaster, who bought it in the same year from Frederich Schutz, of Dresden, and has now been sold by order of the executors of the late Mr. James Hack Tuke, of Hitchin, and was sold for 160 guineas. It may be interesting to point out that six or seven years ago there were only 68 specimens of the egg recorded. The highest price of £300 was paid for a duplicate for the collection of Baron d'Hamonville, of Meurthe, France, two years ago. Shortly after this event two very good specimens were detected among a collection of eggs purchased at a sale in the country for 30s., and were subsequently sold by Mr. Stevens last year for 275 guineas and 185 guineas respectively. A third specimen, Sir. W. Milner's, came into the auction room during last season and fetched 180 guineas. A few years ago a number of exceedingly clever forgeries of the egg were manufactured. Two other interesting eggs were sold immediately after the above mentioned great auk's egg—a very fine specimen, slightly cracked, but otherwise in first-rate condition, of an egg of *æpyornis maximus* realized 40 guineas; and the only example of an egg of *æpyornis grandidieri* ever offered for sale in this country sold for 35 guineas.

The New York State Fish, Game and Forest Commission recommends that an amendment be made to the State Constitution giving the commission power to lease at a nominal price small tracts of the Adirondack preserve to citizens of the State for the erection of cottages or camps. The Commission states that New York owns about 1,000,000 acres of land in the counties constituting the forest preserve (the greatest park in the world), all of which is practically within the Adirondack park. These campers or cottagers would make the very best guardians of the forest, as they would at all times be oresters, game protectors and fire wardens.

The death is announced of Prof. Anatoly Petrovich Bogdanoff in Moscow. *Nature* states that he was born in southern Russia in 1834, and after studying at the Moscow University, and writing, in 1858, his first dissertation on the colors of birds, he became professor of the same University in the year 1863. In connection with this work he wrote an excellent text book of zoölogy, and a still better work, unique in its kind, namely, a *Chrestomathy of Zoölogy*, in three volumes, in which the reader obtains a thorough scientific acquaintance with the different classes of the animal kingdom by means of admirably chosen abstracts from the best authors, considerable attention being given to purely biological questions, and especially to the lowest animals, as well as to their manners of life. In the sixties, Bogdanoff founded, at Moscow, the well-known 'Society of Lovers of Natural Sciences, Anthropology and Ethnography,' whose numerous quarto volumes of *Memoirs* rank among the best scientific publications in Russia, and whose expeditions included the well-known Turkestan expedition of the late Fedchenko and Madame Olga Fedchenko. The chief anthropological work of A. P. Bogdanoff was on the inhabitants of the grave-mounds of the Moscow region. The full list of his nearly forty anthropological, and nearly thirty zoölogical works is given in 'Materials for the History of Zoölogy, pure and applied, in Russia, chiefly for the last Thirty Years,' of which he was the editor, and of which three volumes have already been published. His works for popularizing biology, especially on Darwin's ideas, and for extending the interest in anthropology, are also numerous.

Macmillan & Co. have made arrangements for the issue in New York and London of a *Dictionary of Philosophy and Psychology* under the editorial supervision of Prof. Baldwin, of Princeton University. The work will contain concise definitions, such historical matter as may be necessary to justify the definition given and to show that the usage suggested is the outcome of the progress of philosophy, and full bibliographies. The following contributors are already announced: *General Philosophy and Metaphysics*, Prof. Andrew Seth, Edinburgh; Prof. John Dewey, Chicago. *History of Philosophy*, Prof. Josiah Royce, Harvard. *Logic*, Prof. R. Adamson, Glasgow. *Ethics*, Prof. W. R. Sorley, Aberdeen. *Psychology*, Prof. J. McK. Cattell, Columbia; G. F. Stout, W. E. Johnson, Cambridge; Prof. E. B. Titchener, Cornell; The Editor, Princeton. *Mental Pathology and Anthropology*, Prof. Joseph Jastrow, Wisconsin. *Biology*, Prof. C. Lloyd Morgan, Bristol. *Bibliography*, Dr. Benjamin Rand, Harvard.

WE learn from the London *Times* that the resolution of the Government of India on the annual report of the Geological Survey for the past official year mentions that, although survey work was continued in Rewah, the Central Provinces, and Beluchistan, the amount of work of this kind done was much less than usual, owing to officers being withdrawn for inquiries on economic subjects. The Rewah survey has led to some modification of the views hitherto held in regard to the Vindhyan system, the chief point established being the separation of the lower from the upper Vindhyans. On the northwestern frontier the survey extended to the range between the Luni plain and the Zhob country to the Tochi valley and to the country lying between Dera Ghazi Khan and Zarat. The publications of the Survey during the year include a fresh volume of the 'Palæontologica Indica,' dealing with the fossils from the ceratite beds on the lower trias of the Salt Range, and part of a volume on Himalayan fossils descriptive of the Cephalopoda of the Muschelkalk. This is said to be the first and a very important instalment of the special monographs now being prepared in Europe, for which a special grant has been made by the Government of India. Certain miocene fossils of upper Burma were also treated in a publication of the Survey. As to the economic side of the work of the department, the oil-boring operations at Sukkur were continued without success; in Burma Dr. Noetling brought to a close his inquiries into the occurrence and nature of earth oil; and in various other districts mineralogical surveys have been made, and existing gold and coal mines in Mysore, the Central Provinces and Hyderabad have been visited, while proposals for the regulation of the working of mines in India have been drawn up.

JAMES MERCUR, assistant professor of natural and experimental philosophy at West Point Military Academy, died on April 22d, at West Point. He had been assistant engineer on the survey of the northern lakes and assistant engineer in the removal of Hallet's Point and Flood Rock, Hell Gate, and had charge of various other engineering works.

WE have received from *The Engineering and Mining Journal* advance sheets of Volume IV. of *The Mineral Industry*, giving statistics for the year 1895, from which it appears that the United States last year took the first rank as a producer, not only of the precious metals, but also of the most important of the useful metals, iron and copper, while in coal it is second only to Great Britain. The production of iron in 1895, as compared with that of 1894, showed the remarkable increase of 42 per cent. Steel showed an increase of over 10 per cent. and copper nearly an equal increase. Coal shows an increase of ten per cent. Silver is the only important product showing a decrease.

THE London *Times* states that important alterations are in progress in the Natural History Museum. Many of the less important specimens have been removed to store rooms, leaving space free in the exhibition galleries. The marsupials have been entirely rearranged and maps have been prepared showing their geographical distribution. A gallery in the western corridor has been set aside for the antelopes, and the unrivalled series of British birds has been removed to the ground floor. Space has been found for the birds through the rearrangement of the reptile gallery. Other changes are also in contemplation, as, for instance, in the first gallery, where the larger fishes are now seen suspended from the roof, so as not to cumber valuable floor space; while on the geological side there are signs of the approaching abolition of the hard-and-fast division which has so long separated paleontology from zoölogy and botany. Thus there may now be seen in the gallery of fossil mammalia skeletons of the Indian elephant, Indian rhinoceros and musk ox, placed for comparison with the fossil forms. 1,225 separate gifts, many of them comprising a large number of specimens, such as the Seebohm bequest, were received by the Museum last year.

IN his address, as President, before the Lincoln Microscope Club, Prof. Bessey stated, according to the *Microscopical Journal*, that microscopes are extensively used in the public schools of Nebraska, most of the high schools owning at least six.

Popular Astronomy states that at the last session of the Illinois Legislature an appropriation was made for the erection and equipment of an Observatory for the State University at Champaign. The designs for the building were made, under direction of Prof. Ira O. Baker, by the Architectural Department of the University. The instrumental equipment, consisting of a 12-inch equatorial, a 3-inch combined transit and zenith telescope and a chronograph, will be made by Warner & Swasey, the optical parts being made by Brashear. This makes four universities which have established observatories within the past year, all of which have ordered telescopes from Warner & Swasey, with optical parts by Brashear. The list is as follows: University of Pennsylvania, Philadelphia (18-inch aperture); University of Ohio, Columbus (12-inch aperture); University of Minnesota, Minneapolis (10½-inch aperture); University of Illinois, Champaign (12-inch aperture).

A CATALOGUE of the types and figured specimens of fossil animals in the United States National Museum has been recently completed, and comprises type material representing 3,644 species, distributed as follows: Invertebrates, Palæozoic, 1,155; Mesozoic, 1,024; Cenozoic, 1,312; Vertebrates, 163. The fossil plants are not yet fully catalogued, but it is known that they represent more than 2,000 species, over 500 of them being contained in the 'Lacoe Collection' alone. There are in round numbers 500 Palæozoic, and 1,500 Mesozoic and Cenozoic species. Every type or figured specimen is made conspicuous by attaching to it a small, green, diamond-shaped ticket, or a white ticket bearing the word type. Should any specimen be separated from its label this ticket will draw attention to the fact that the specimen is a type and must be cared for.

UNIVERSITY AND EDUCATIONAL NEWS.

JOHNS HOPKINS UNIVERSITY has published on the occasion of its twentieth anniversary statements concerning the university which bear witness to the important part it has taken in the advancement of higher education and research in America. The University has conferred 358 degrees of Doctor of Philosophy, and of these graduates 175 hold college professorships. Eight hundred students of the University have engaged in teaching, and nearly every university and college in America numbers among its faculty a student of Johns Hopkins University. The following institutions have had in their faculties ten or more of its students: Chicago, 23; Wisconsin, 19; Bryn Mawr, 18; Stanford, 17; Michigan, 17; Pennsylvania, 16; Cornell, 14; Columbia, 13; Massachusetts Institute of Technology, 11; Nebraska, 11; Northwestern, 11; Harvard, 10; Woman's College of Baltimore, 10. There are now in the University 403 graduate students of which 150 are candidates for the degree of M. D. or physicians attending special courses.

THE catalogue of the University of Minnesota for 1895–96 shows the following enrollment for the year:

Graduate Students, all departments,	137
Undergraduates:	
College Science, Literature and Arts,	822
College Engineering, Metallurgy and the Mechanic Arts,	192
College of Agriculture:	
Collegiate Course in Agriculture,	10
School of Agriculture,	223
School of Dairying,	97
School for Women,	46
College of Law,	369
Department of Medicine:	
College of Medicine and Surgery,	243
College Homœopathic Medicine and Surgery,	31
College of Dentistry,	90
College of Pharmacy,	33
Summer School,	234
	2527
Students enrolled in more than one department,	38
Total,	2489

THE Massachusetts Institute of Technology has issued a circular calling attention to the opportunities it offers to college graduates. There are this year 80 such students in the Institute, 69 of whom are from other institutions. The summer courses offered by the Institute are especially planned for advanced students.

AT the celebration of Founder's Day of New

York University on April 22d the corner stone of the first residence hall was laid. The building, which will be ready for use in September, will contain, in addition to rooms for 112 students, a music room, editorial rooms for the college periodicals, etc.

PROF. GEORGE S. FULLERTON, Vice-Provost of the University of Pennsylvania and Dean of the College, will retire from the latter office and will be succeeded by Prof. W. A. Lamberton, who in turn will be succeeded in the deanship of the School of Philosophy by Prof. W. R. Newbold.

DR. ERNEST B. SANGREE, of Philadelphia, has been elected professor of pathology and bacteriology in the Vanderbilt University, Nashville, Tenn.

DISCUSSION AND CORRESPONDENCE.

ON ROOD'S DEMONSTRATION OF THE REGULAR OR SPECULAR REFLECTION OF THE RÖNTGEN RAYS BY A PLATINUM MIRROR.

ON March 27th Prof. Rood published in this JOURNAL a short account of certain experiments which he claimed 'pointed strongly to the conclusion that in the act of reflection from a metallic surface the Röntgen Rays behaved like ordinary light.' If this sentence means anything, it means that the X-rays underwent regular or specular reflection. On April 10th, however, Dr. M. I. Pupin published in this JOURNAL an article in which he says, "If I understand Prof. Rood's words correctly, no claim is made by him of a discovery of regular or specular reflection;" and he then quotes from Rood the sentence given above. The remainder of Dr. Pupin's article is largely devoted to showing that with the methods employed by him no regular or specular reflection could be observed. This last conclusion we are ready to accept. Prof. Rood's experiments, however, were conducted in an entirely different manner, as follows:

Before reaching the sensitive plate the X-rays were obliged to traverse two aluminium plates, each having a thickness of .17mm., and behind them was a drawslide that had proved to be impervious to the sun's light falling on it during two hours. Over these shields was placed a wire netting with openings of $\frac{1}{8}$ inch. The reflecting surface was a large piece of bright platinum foil, seven inches square. This last was necessarily so arranged that a diffused reflection from it would have reached all parts of the sensitive plate. In point of fact, however, an image of the wire netting was obtained only on a strip of the plate, viz., on that portion that would be reached by the Röntgen rays in case of their regular or specular reflection.

The proof that the image of the wire netting on the sensitive plate was really produced by the *specular reflection* of the X-rays from the platinum was obtained in the following manner. The plate which had received the image of the netting made by the X-rays was removed from the plateholder and replaced by a fresh plate; this plate was not screened at all, but its sensitive surface was freely exposed in the dark at night.

Everything else in the arrangement of the experiment, including the position of the netting in front of the plate, remained as it was during the experiment with the X-rays. One flash from the inductorium was sent into the Crookes tube and the experiment was ended. On developing the plate it was found that *the light* from the Crookes tube had exactly reproduced in a fraction of a second what had required ten hours of action of the X-rays. There was the same portion of the plate acted on by the light as had been acted on by the X-rays, and the image of the netting given by the X-rays was reproduced by the light, not generally reproproduced but minutely so; all the deformations of the image of the netting resulting from the reflection from the uneven surface of the platinum foil were alike in the photograph obtained by the X-rays and in the photograph obtained by the light.

I paid repeated visits to Rood's laboratory during the progress of these experiments, and after a careful examination of his negatives no doubt remained in my mind of the fact that he had demonstrated the regular or specular reflection of the Röntgen rays.

Prof. Rood carried these and other similar negatives to Washington, where he read a paper on the reflection of the X-rays before the National Academy of Science on April 23d.

The original negatives were carefully examined by the physicists present, Prof. Rowland devoting half an hour to their critical examination; and I do not think that the slightest doubt was held, by any of the six physicists present, of the completeness of the demonstration.

I cannot conceive how Dr. Pupin, after an examination of Rood's photographs, could differ from, deny, or even doubt, the conclusions reached by several of the most critical and experienced physicists of the country after their examination of these photographs.

ALFRED M. MAYER.

PSEUDO-SCIENCE IN METEOROLOGY.

IN the issue of SCIENCE for April 10th nearly a full dozen columns of valuable space have been devoted (under a rather misleading title) to recording observations and opinions which are to prove the absence of a favorable influence of forest cover on meteorological phenomena and especially on waterflow in the Western Mountains.

Since this subject has become not only one of considerable scientific interest, but also of great national importance, far-reaching economic policies depending in part on the answer which science or well sustained observation and argument can give to the question, it may not be out of place to devote further space to the question in order to warn against the many erroneous observations and fallacious conclusions contained in the article referred to.

I do not wish to offend the writer when I say that by neglecting to sift more carefully the untutored and too-often-prejudiced opinions and notions of so-called 'practical' men at the hand of the *established* facts of science, physical, physiological and meteorological, he has done harm; for he has not only increased the accumulations of 'practical' or pseudo-science, to which to be sure, many so-called 'scientists' contribute no small share, but he has also discredited the sometimes valuable—when used with discretion—observations of laymen with those men of science who read with a knowledge of the laws of physics and the facts of meteorology before them.

Sure enough meteorology, especially on the side of accurate measurements, is but poorly developed ; nevertheless there is much more real knowledge in existence regarding many of the physical processes and conditions involved, not only qualitatively, but even quantitatively (as, for instance, regarding the behavior of snows, the evaporation of water, the transpiring of trees, and the conditions which influence these and the run-off and waterflow of rivers) than the writer of the article is aware of, so that it is not necessary to rely on *opinions* of 'practical' observers for these details at least.

I wish, however, not to be understood as discrediting in any way field observations and argument from them and as insisting upon accurate measurements as the only basis for the explanation of natural phenomena. On the contrary, I am one of those who believe that many complicated natural phenomena withdraw themselves for the present, *i. e.*, with our present knowledge and means, from accurate measurement; being results of complex and variable conditions which we are not prepared to measure, we may only by careful, long continued field observation and upon sound argument from well-known physical laws come to conclusions and determine relations qualitatively, leaving quantitative measure of these relations to be worked out in the future with improved method.

The present question, namely, that of forest influences on meteorological phenomena, is one of these, for in the first place we have as yet neither instruments nor methods to measure with any determinable degree of accuracy the rainfall over a given area, much less the evaporation; and even riverflow is not yet satisfactorily measured. And when it comes to the many varying influences affecting these phenomena quantitatively, we are entirely debarred from speaking with assurance even as to methods of determining them.

It would require too much space to discuss in detail the many erroneous statements and conclusions contained in the article referred to and which any meteorologist or physicist can readily discover. I shall have to confine myself to pointing out the fallacy of the main argument, which appears the more important as it has been advanced before by others with a flavor of authority. This argument is, if I understand it correctly, that in the Western mountains the riverflow is dependent on the accumulation of winter snows ; that on the open ground these snows are drifted, accumulated and packed together, whereby the melting of the snow is retarded and the supply of available water prolonged; that in forests the snow melts sooner, because lying less thick; that various other causes, like mechanical obstruction to the snow in reaching the ground, transpiration, greater evaporation under trees, etc., reduce the available water supplies and hence that forests as far as waterflow is concerned are an evil. This deleterious effect, by the way, is argued almost in the same breath with which the statement is made that the forest growth in these mountains is so open, casts so little shade, accumulates so small amount of litter and offers so little obstruction to sun and wind that its effect in shading and protecting the soil and reducing evaporation may be set down as *nil*.

Now it is true that the rivers of the Sierra rely for their supply mainly on the snow waters, hence any conditions which preserve and lengthen this supply, will influence the quantity and continuity of the river flow. If, therefore, the snow drifts melt more slowly and at the same time give as much available water in proportion to the amount of snow fallen, this would be an advantage. The slow melting is true, however, only for high altitudes above timber line, which represent a comparatively small area; below timber line the snow drifts are all gone long before midsummer, and it is only with such as lie at similar altitudes, and hence under similar temperature and wind conditions, that the condition of the snow under forest cover may be compared; here even this seeming advantage of the snow drift, the slower melting, will be found not as great.

But the very length of time during which these snow masses are exposed to the other dissipating influences, especially the 'dry air of the mountains,' on which the writer dwells with particular emphasis, is detrimental to the amount which becomes available to the soil. It is, therefore, by no means certain whether the quantity of water delivered to the soil is in any relation to the time during which it is delivered. Knowing from tolerably reliable measurements the enormous evaporative power of air, especially when in motion, with high velocities of wind such as are common in high altitudes, we have good reason to doubt this, although undoubtedly the drifting, and hence reduction of exposed surface, reduces this loss somewhat.

It would appear much more desirable to have the snows melt quickly, provided their waters have time and opportunity to sink into the soil and away from the dissipating influences of dry air and wind, which are bound to rob the exposed drifts and leave less water for the soil. And here we reach the most important lack in the writer's argument and the most important claim of those who argue an influence of forest cover on waterflow, namely, as to the manner in which the rivers receive their water.

Even if we grant, for argument's sake, the unsubstantiated assertions of the writer, that the forest cover on these mountains is too sparse to exert any but deleterious influences with regard to conservation of snows, a contradiction in itself, he overlooks the most potent effect, which even the stumps as well as all shrubs and young growth have on the penetrability of the soil for the water.

He overlooks, as most writers on the subject do, the fact that it is not so much the surface drainage which reaches the rivers that forms the desirable supply, as the subterranean or ground waters. Surface drainage means rapid flow, high water stages, alternating with low water, uneven distribution through the year. Subdrainage means less excessive water stages, more even, steady and persistent flow, for the ground water reaches the river sometimes only *several years* after it first sank into the soil, and hence equalizes the effects of dry and wet seasons while the surface waters are carried off at once and are responsible for floods, followed by low water. Anything, therefore, that tends to change surface drainage into subdrainage is to be encouraged.

If there were, therefore, no other means by which a forest cover acted as a preserver of water supplies, the mere existence of the root system, penetrating the soil in all directions and facilitating percolation of the water, would be beneficial.

In this way, if the observation that after the removal of the old timber in Nevada the water-flow was more even be correct (which I hesitate to accept), it would find explanation in this, that the stumps and roots decayed and thereby increased the channels for the percolation of surface waters.

In conclusion I would say, that geological structure and soil conditions may be such, that percolation takes place readily even without the additional aid of a forest growth, when the effect of the latter may become irrelevant, although as a rule it may be accepted as a result of forest removal and exposure of soils, when new growth is at the same time prevented by fires and by sheep herding, that all soils become gradually more compact and less penetrable; that then more water goes over the surface and less remains for subdrainage and that ultimately the change is felt in the riverflow.

B. E. Fernow.

Washington, D. C.

ZOÖLOGY AND BIOLOGY.

To The Editor of Science: It is astonishing to find in your columns the assertion, p. 634, that the Johns Hopkins University sends out 'Doctors of Philosophy in Biology,' for you might have learned so easily that no such degree is known among us.

The examining board recommends for the degree of Doctor of Philosophy those students who have satisfactorily completed a course of study which this board has previously approved; and among all those who have been recommended for this degree during the last twenty years not a single one has presented himself for examination in biology, although many have been examined in various branches of biological science.

W. K. Brooks,

Professor of Zoölogy in the Johns Hopkins University.

Baltimore, April 28, 1896.

[The criticism of Professor Brooks is directed against a letter signed by Professor Conway MacMillan, of the University of Minnesota. Science is not responsible for the opinions of its correspondents. Ed.]

THE USE OF THE TOW-NET FOR COLLECTING PELAGIC ORGANISMS.

Editor of Science: I have so frequently seen the first use of the tow-net as a means for collecting pelagic organisms placed to the credit of Johannes Müller that I suspect many zoölogists are, as I was till recently, ignorant of the fact that Eschscholtz employed the apparatus some twenty years earlier than Müller did.

In Eschscholtz's 'Review of the Zoölogical Collection,' appended to the second volume of 'A new Voyage round the World,' by Otto von Kotzebue, I find the following on page 327: "The calms near the equator afford an abundant harvest to the zoölogist, the tranquil water presenting an immense variety of marine animals to his view, and allowing him to take them with little trouble in a net. The open woolen stuff used for flags offers the most convenient material for making these nets, as it allows the water to run through very quickly and does not stick together. A short wide bag should be made of this stuff, which may be stretched upon the hoop of a cask, and the whole fastened to a long, light pole. From the height on which we stand above the water it is impossible to perceive the smaller animals; the best way, therefore, to catch these is to hold the net half in the water, as if to skim off the bubbles of foam from the surface; then, after a few minutes, if the net is drawn out, and the interior rinsed in a glass of fresh seawater, one may frequently have the pleasure of seeing little animals of strange forms swimming in the glass. In the course of ten days I obtained, in this way, thirty-one different species of animals."

Eschscholtz does not tell us exactly when he began this kind of collecting; but the voyage on which he did it was during the years 1823, '24, '25 and 26; and as the above quotation is taken from the account of his observations in the tropical Atlantic before reaching the coast of Brazil, it certainly relates to the earlier part of the voyage.

In the last one of his series of papers on the development of Echinoderms, published in 1852, Müller tells us that he had used the tow-net 'vielen Jahren mit dem besten Erfolge.' The 'vielen Jahren,' I suppose, refers to the years during which he was prosecuting his beautiful researches at Heligoland, Trieste and Marseilles, and these he began in 1845.

Very likely other zoölogists as well as Eschscholtz used the tow-net before Müller. One can hardly see how an ardent collector of marine animals could have escaped resorting to something of the kind, even though he had never before seen such a thing.

WM. E. RITTER.
UNIVERSITY OF CALIFORNIA.

SCIENTIFIC LITERATURE.

The Principles of Sociology. By FRANKLIN H. GIDDINGS. Pp. 476+16. Macmillan & Co., New York. 1896.

Sociology has had a checkered and disappointing career. Its study began not because there was a body of men ready to devote their energies to its advancement, but because certain system makers found what they supposed to be a vacant field to which some attention must be given. The men who have done the most from this point of view are Comte and Spencer, though the main interest of neither lay in the development of this field. For these philosophers 'sociology' became the depository of the odds and ends of thought for which no other convenient place could be found. It is needless to say that such a method failed. The creators of a science must live in it, and with this condition these system-makers did not comply.

This new field, this land along the edge of which Comte and Spencer sailed, supposing it to be unoccupied, had residents and tillers. Its aboriginal inhabitants were called economists and, even though not recognized by the system-makers, had really created a science. It is not to be claimed that the whole field was cultivated or even that the occupied portion was cultivated to the best advantage. But work of a permanent character had been done and, at the same time, public opinion had been reconstructed in many important respects. It is the fulfilment of these conditions that justifies the claim of any science.

The second attempt to found a sociology grew out of the shortcomings of these economists. Those who resisted the narrowing tendencies of the definite creed formulated by the economists found sociology a convenient name and took it to designate their field. But the latter were moved too largely by their sympathies to be scientific workers, and their energies were spent more in denouncing the hard-hearted economists than in formulating better laws. Sociology with them remained, as with the system-makers, a dumping ground for the crude doctrines and rubbish rejected by the economists. Such work and such men could scarcely found a science.

To neither of these causes is due the new American sociology. Professor Giddings is not a wandering philosopher looking for a job, nor is he an outcast economist of the soft hearted variety. Among economists no one has a better reputation. By his good work he has earned a place in their ranks and he leaves them with their hearty good will. The cause of the new movement lies not in personalities nor quarrels, but in conditions—conditions that can be made plain only by a restatement of the history of economic thought.

The science of economics is a product of Eighteenth Century rationalism. By the philosophers of the last century it was assumed that man was a reasonable being. Customs, habits, national feelings and the like were thought to be remnants of past conditions, due to the oppression from which the race still suffered. Conscious calculation should be the only guide; expediency the only rule of action. Each decision was to be made by a summing of utilities. The free man should have only two masters, pleasure and pain.

With such premises the social sciences could be divided into only two parts, economics and utilitarianism. Economics treated of the material sources of pleasure, the influence of the environment on their production and the pains which this production involved. The older forms of ethics, politics and law were to be displaced by utilitarianism, thus including within its scope all decisions where the pleasures and pains were immaterial. Welfare reckoned in material goods was economics; welfare reckoned in units of pleasure was utilitarianism. No rational being should consider other motives, and in time they would disappear through the elevation of the race. While this distinction between economics and utilitarianism seems logical, it was obliterated by the subsequent development of economics. In the newer economic theories the measurement of welfare in units of satisfaction has displaced the old measurement of welfare in units of commodity. Each material good is valued by the satisfaction its consumption yields, and this satisfaction depends upon the quantity of goods already possessed. This is, in short, the theory of marginal utility which has revolutionized economic thought. It is of importance in the present connection because it destroys the difference between utilitarianism and economics. Utilitarian ethics is but a species of economics. There can be but one science of conscious motives. Conscious calculation is confined to a field where the influence of the environment is direct and where the actions of men are determined by a few dominant motives prompted by pleasure and pain. Perhaps the name economics is not a good one to designate this field, but it has been so monopolized by economists that it will be hard to displace.

Nineteenth Century progress, however, has not justified the hopes of the rationalists of the last century by making economics the only social science. Men have not become mere calculating machines. On the contrary there has been a revival of those modes of thought which seemed moribund. Custom and habit still hold their own; national spirit has shown its vitality in a way that would have astonished the cosmopolitan rationalist; while in law the old standards and customs have endured in spite of the attacks of Bentham. In ethics and religion the revival has been equally notable. What rationalist would have thought that Nineteenth Century ethics would be transcendental, or that its religion would be dominated by Methodism instead of by Unitarianism?

This failure of the utilitarian philosophy is too apparent to be overlooked. It shows that there was some defect in the analysis of its advocates. They assumed that the influences of the physical environment were greater, and the motives of men simpler, than later reflection shows to be the facts. The reasoning of the utilitarians might be saved by admitting a difference between positive and absolute utilities. Positive utilities are made up of units of pleasure and they can best be secured by conscious calculation. Absolute utilities are, however, necessities upon which life depends and they can best be guarded by strong impulses which compel each man to secure them. In biologic language it might be said that each man and race has certain requisites for survival and certain requisites for welfare. The first group is secured by mental modifications generating strong desires and impulses acting too quickly to admit of calculation. The realm of welfare alone remains open to conscious motives and here the rationalistic attitude is supreme.

It makes little difference what line of reasoning a person uses to convince himself of the inadequacy of the old rationalistic program. The patent fact is that economic philosophy is not the whole science of human nature. Economics has succeeded by its emphasis of a partial man, and to include a study of the whole man in it, as some would have us do, would vitiate its best results. A glance at the history of the other social sciences will show that they have not filled the gap created by the defects in the utilitarian philosophy. Politics in the Aristotelian sense might have been such a science. Its field, however, has been narrowed until it is little more than a history of parliamentary government. Professor Freeman's doctrine, 'history is past politics and politics is present history,' shows how the fields of history and politics have blended. History has developed from a record of kings, battles and dates into a study of institutions. Utilitarian ethics has been absorbed in economics, just as politics has been absorbed in history, while transcendental ethics is more a history than a theory of ethical ideals. Law, like politics, has become a branch of history; its method is comparative and in it pure theory has no place.

It is evident that history is the only branch of the social sciences which has kept pace with economics. These two subjects have been vitalized by Nineteenth Century thought and have grown until, between them, they have absorbed all the social sciences. Only the historical and economic methods of study have been fruitful of results. Students of social science are either historians or economists, and what is not economics is history. This failure of the other social sciences to develop a theory corresponding to economics has given to sociology its opportunity. Both economics and history will be benefited by a new science including the theoretic elements outside of economics and foreign to history. History cannot become theory without losing its intrinsic qualities, nor can economics absorb social theories without losing its purity and method. The only solution of the difficulty lies in a new theoretic science doing for other portions of social science what economics has done in its field. Economics would then remain a study of the environment and of the simple motives upon which conscious calculation depends. Sociology would give us a theory of human impulses, tradition, imitation and other forms of activity outside of conscious calculation.

There is at present no good word to designate the field outside of utilitarian calculation, and this fact prevents us from seeing its extent and importance. To it our institutions, national life and party feelings belong, as do also the moral, religious and æsthetic ideals of the race and the customs and habits of individuals. These are means of eliminating conscious calculation and through them the promptness, efficiency and regularity of actions are increased. For want of a better term, I am inclined to call all these extra economic elements the *socialry* of the race. I would use this term in so broad a sense as to include every device or habit or motive by which men are united and their activities harmonized. Together they make up a subjective environment which influences the conduct of men fully as much as does the physical environment upon which the economic motives depend. This socialry of men is the subject-matter of sociology, just as their goods are the subject-matter of economics. The latter science treats of the conscious economies due to the simple reactions between the environment of men and their desires; the former treats of the unconscious economies due to heredity and to the psychologic motives which it creates. The two theories supplement one another and when properly harmonized with history would complete the social sciences.

The distinctive merit of Professor Giddings' work is that it is neither economics nor history. It might be denied that he has created a science, but not that he has found a new field and devoted his energies to its exploitation. Too much of the so-called sociology is really disguised economics and elementary biology. The economist recognizes old friends when the sociologist talks of the sustaining system, the circulatory system and the stratification of society. The restatement of old doctrines and ideas may revolutionize a science, but it does not create a new one.

The chapters on Social Population and on the Social Constitution are among the best in the book. It is here that the method of Prof. Giddings shows itself to the best advantage. The problems of anthropology and ethnology are also fully and ably handled. Of the other parts I like best of all the discussion of tradition and of social choices; on these topics he shows the greatest originality. I have not the space to take up these or other doctrines in detail, nor would such work be of much value. A useful book must be read to be understood. A critic can point out merely wherein its value lies and save the student from the heavy burden of reading everything. In this book much more stress is laid on the harmonious relation of the various parts than on particular discussions. Its aim is to interest people in a new science, and in this its success lies. SIMON N. PATTEN.

UNIVERSITY OF PENNSYLVANIA.

Water Supply (considered principally from a sanitary standpoint). By WILLIAM P. MASON, Professor of Chemistry, Rensselaer Polytechnic Institute. New York, John Wiley & Sons. 1896. 504 pp., 8vo.

The subject of the water supply of communities has always been an interesting one, and it has been known for more than two thousand years that the character and amount of sickness and death in a town or city is at times greatly influenced by the quantity and quality of the drinking water of its inhabitants; but it has only been within the present century that any precise and definite information upon this subject has been obtained.

Cholera and typhoid fever epidemics due to a water supply contaminated with the discharge of a person suffering from one of these diseases have now been observed and recorded in sufficient number, and with enough accuracy, to have convinced both scientific men and the public that this is the most common cause of great outbreaks of these diseases, and that the spread of the specific bacteria which produce them is the means by which such impure waters produce their destructive results. The work of Professor Mason presents abundant evidence of this in the form of statistics of different cities, and of records of individual outbreaks, and gives a fair summary of existing methods of testing and of purifying water supplies. In the chemical part of the book the writer gives his own experience in water analysis, and the directions are clear, concise and well up to date. He confirms Dr. Smart's remarks as to the importance of the rate of evolution of the so-called albuminoid ammonia, in the distillation process, but it is curious that no allusion is made to the fact that the prolonged giving off of albuminoid ammonia indicates, in many cases, the presence of urea, and, therefore, of sewage, in the water.

The chapter on the artificial purification of water is a good summary for the general reader, but it is not made as clear as it should be that, in large sand filtration plants, no single filter bed should exceed a certain size, say one acre, and that the effluent from each filter bed should be tested bacteriologically at least once a week, and in many cases once a day. In other words, a small bacteriological laboratory and the services of a skilled bacteriologist are essential features of such a system of filtration.

Among other epidemics of typhoid fever described is the well known one at Lausen, in which the infected water passed through the base of a mountain, and such passage was demonstrated by adding salt to the water. Flour was also added, and did not pass through, but it is doubtful whether this is a satisfactory proof that the water was really '*filtered*' in its passage.

Taking it altogether this is decidedly the best book on water supplies that has yet been produced for American readers and as such it is cordially commended.

SCIENTIFIC JOURNALS.

PSYCHE, MAY.

THE leading article by Prof. V. L. Kellogg gives a general account of the Mallophaga, with a key to the genera. W. S. Blatchley continues his account of the winter Coleoptera of Vigo Co., Ill., and Mr. A. P. Morse his notes on N. E. Tryxalinæ. J. W. Folsom examines the types of Packard's *Papirius texensis*, and finds two species among them, one a Papirius, the other a new species of Smynthurus, which he describes. H. G. Dyar describes the larva of *Cautethia grotei.* T. D. A. Cockerell reviews Dalla Torre's recent catalogue of bees, and F. C. Bowditch gives some notes on the habits of two beetles. Miscellaneous notes complete the number.

THE PSYCHOLOGICAL REVIEW.

THE articles in the May number are researches from the psychological laboratories of Chicago, Harvard and Wisconsin. From Chicago, Prof. Angell and Dr. Moore report on reaction-time experiments in which the attention was alternately concentrated on the attention and on the movement, the stimulus being a sound or a light, and the movement being made with the hand, foot or lips. The reaction-times were on the whole shorter when the alteration was motor, but not to the extent nor with the regularity claimed by the Leipzig experimenters, and the distinction tends to be obliterated or reduced by practice. The authors discuss their results in their relation to attention and habit. In a second research from Chicago, Mr. L. G. Whitehead communicates experiments on visual and aural memory which show that of the thirteen observors tested, ten were able to memorize more rapidly when the series was seen and two when it was heard, while in one case the result was doubtful. Matter memorized aurally appeared to be retained slightly better than that memorized visually.

Dr. Edgar Pierce, now of the University of Michigan, publishes experiments carried out in the Harvard laboratory on the æsthetics of simple forms with special reference to eye movements. He determined the preferences of different observers for figures in different positions, and concludes that an object satisfies æsthetic demands when the objective conditions fulfill the suggestions aroused by it. Mr. Lough describes a new perimeter made for the Harvard laboratory in which the stimulus is stationery and the fixation point movable.

Mr. F. E. Bolton has repeated and varied, with students at the University of Wisconsin, the experiments on the accuracy of recollection and observation suggested by Prof. Cattell and published in this JOURNAL (Dec. 6., 1895). The scientific students showed greater accuracy of observation and memory than the classical students, and this held even in regard to literary information. The average of the classical students gave 1839 as the date of Victor Hugo's death!

Under Discussion and Reports are given the discussion by Profs. Ladd and Baldwin on consciousness and evolution before the American Psychological Association; Dr. Nichols claims that the existence of specific nerves for pain has been proved; Prof. Herrick writes from his own experience on the testimony of heart disease to the sensory facies of the emotion, and Mr. G. M. Stratton discusses the relation between psychology and logic.

The number concludes with reviews of recent psychological literature, contributed by sixteen writers, and notes.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 260TH MEETING, SATURDAY, APRIL 18.

WM. H. DALL exhibited two skins of the Glacier or St. Elias bear of Alaska (*Ursus Emmonsi*, Dall), kindly lent for exhibition to the Society by Mrs. Admiral Emmons. He stated that the skins from which the original description in SCIENCE (N. S. II., p. 87, July 26, 1895) was made, were probably summer skins, the hair being shorter and darker than in those shown, which appear to be winter skins, in which the larger part of the hair is white and much thicker and more woolly, the general tint being hardly darker than in the gray wolf of Alaska. These skins had been dressed and trimmed by a furrier, so that the extremities of the head and limbs were defective, but the peculiar breadth of the head and the remarkable bluish gray coloration of the entire coat indicated an animal specifically distinct from any American bear hitherto known, but more nearly allied to the black than to the brown bears. This opinion, he said, is shared by Dr. Merriam, Mr. True and other students of mammals who have examined them. Earnest efforts are being made to obtain a skull and skin suitable for mounting during the present season.

Under the title *Preliminary Notes on Middle Cambrian Medusæ*, Chas. D. Walcott, of the U. S. Geological Survey, briefly outlined the character and scope of an extended review of the fossil medusæ, prepared by him. He stated that the preliminary announcement of a review of the fossil medusæ of the Middle Cambrian terrane must be modified, as during the last two months the scope of the work had been broadened and a memoir including not only the fossil forms of the Middle Cambrian, but also those of the lower Cambrian and of the Jurassic of Europe, had been practically completed.

A description was given of the mode of occurrence, conditions and manner of preservation, and the interrelations of the fossil and living medusæ, including an account of some interesting experiments that he had made of the phenomena attending the preservation of recent or living forms.

The numerous plates with which the memoir will be illustrated were shown, 45 being devoted to fossil forms and 7 or 8 illustrating the relationship to recent species.

B. E. Fernow described a *Pine Coppice* in New Jersey, being a remarkable area known as the East and West Plains of nearly 15,000 acres extent, covered with a growth of *Pinus rigida*, sprouting from the stump.

In spite of the poor, shallow, sandy gravel soil with an impenetrable subsoil, hardpan and bog ore underlying it and a periodic recurrence of fires, these pines maintain themselves in a regular coppice. Among the specimens exhibited there was a root bearing two sprouts which had evidently been developed into trees one after the other, the older burnt out, the younger showing 83 years of growth, pointing to a persistence of the root of probably over 150 years.

Since the sprouting from the stump of conifers, especially pines, is most unusual and at least the persistence of the sprouts has generally been doubted, this exhibit under the specially unfavorable conditions cited is of great interest.

The well-observed capacity of the species to develop adventitious buds seems here to serve for the purpose of maintaining the occupancy of the soil. Cones develop on 3 to 5-years-old sprouts, but germinative seeds are rarely found.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 43d meeting, held in Washington, D. C., April 22, 1896, communications were presented as follows: 'A new Laccolite Locality in Colorado and Its Rocks,' by Mr. G. K. Gilbert and Mr. Whitman Cross; 'The Origin of some Mountain Scarps,' by Mr. M. R. Campbell.

Mr. Gilbert described a laccolitic locality discovered last summer in southern Colorado. Dakota and older rocks are bent into a dome with a height of 1,000 feet and a width of 5 miles. Many dikes traverse this and two laccolites are exposed in partial section. The horizons of intrusion are more than 600 feet below the base of the Dakota. The date of intrusion is approximately indicated as Eocene or late Cretaceous. The intruded rock is more basic than is ordinarily found in laccolites and is much more easily disintegrated by weathering. The neighboring sandstones and those portions of neighboring shales which have been baked by the intrusions resist erosion better than the igneous rocks, so that the laccolites find topographic expression in valleys instead of hills. A mass of altered sandstone, protecting a pedestal of shale and igneous rock, stands prominent above the country, constituting the crest of Twin Butte, the most conspicuous landmark of the region.

The rocks of the laccolite and dikes were described by Mr. Whitman Cross. The rock of the laccolite and of most of the dikes is a basic syenite porphyry, in which the ferromagnesian silicates, augite, biotite and olivine, exceed the feldspathic constituent. Augite is the predominant silicate. These rocks are allied to a large series from the plains of Colorado and New Mexico, to be described hereafter.

Mr. M. R. Campbell discussed the origin of the eastward facing scarp of the Blue Ridge throughout North Carolina, which has been attributed (1) to the action of sea waves on an elevated coast, (2) to the normal erosion of a broadly uplifted peneplain, and (3) to deformation produced by radial movements in the crust of the earth. The first and second theories he regarded as obsolete or insufficient. The third theory seems to offer the best explanation, but deformation alone could hardly produce the present scarp; there seems to have been modifying conditions which have not heretofore been formulated, but which were probably the immediate cause of the scarp production.

No radial movement is known to have occurred in the Appalachians of sufficient intensity to produce so steep a scarp, but if, during a period of baseleveling, a slow monoclinal uplift occurs, the portion of the region which is beyond the influence of the uplift will remain at baselevel, whereas in that portion in which the movement is at a maximum the process of baseleveling will be interrupted producing a very different succession of topographic forms. There will be an intermediate zone in which the forces of elevation and degradation will be balanced against each other.

If the movement is relatively rapid the peneplain will encroach but slightly upon the uplift. If the movement is slow the peneplain will encroach to a much greater extent not only along the streams, but in the inter-stream areas also. The result of this encroachment is to accentuate the slope produced by the uplift, and if the movement is extremely slow the slope will become a scarp.

If this hypothesis is correct the peneplain which caps the Blue Ridge is continuous with the Piedmont plain at a very short distance from the foot of the ridge, but the intermediate, or sloping, portion of the old peneplain is almost completely removed by more recent erosion along the zone of tilting.

In the vicinity of Roanoke, Va., this uplift turned toward the north and crossed the Appalachian valley. In this portion of its course similar results were produced, but the rocks are not hard enough to preserve the scarp as they do further south. In crossing the Appalachian valley this uplift protected the basin of New River against the encroachment of the Atlantic streams, which otherwise would, doubtless, have captured its headwaters. In this region also some of the tilted portion of the older peneplain is probably preserved in an intermediate level which some observers have classed is a distinct peneplain.

It seems probable that in other regions local uplifts have occurred during the continuance of periods of extensive baseleveling, and if so similar forms have probably been produced.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, APRIL 21.

MR. LEWIS WOOLMAN described the imbedded trees in the cedar swamps of Cape May Co., N. J., from which cedar shingles are manufactured. The lumber men distinguish two kinds of logs: those from 'windfalls' or trees overturned with their roots and 'breakdowns' or those broken off by the wind or other agency. The wood of the former is always well preserved, while that of the 'breakdowns' is not generally in as good condition. From a sound trunk 32 feet long 4,000 cedar shingles have been cut. The tree contained upwards of 800 rings of growth, and the wood when cut emitted a distinct odor.

Mr. A. E. Brown stated that he had recently had an opportunity of examining in the British Museum a cast of the portion of a skull of *Pithecanthropus erectus* discovered by Dr. Dubois. An examination of the cast supports the opinion advanced by Cope and Allen before the Academy that the remains as described and figured by Dubois present no characters separating the species from *Homo Neanderthalensis.* The Java skull is possibly a little flatter than the Neanderthal specimen, but this is purely individual and is compensated for by a bump over the coronal suture. It is also a little more inflated postero-laterally, the supra-orbital ridges being perhaps not quite so thick, although they project as much, if not more. The Java skull is about five-sixths or seven-eighths the length of the other, the cubical capacity being somewhat less.

The phylogeny of man and the apes was considered by Messrs. Rothermell, Brown and Chapman.

Anthropological Section, April 10. Charles Morris, Recorder. Prof. Witmer made a communication on the relations of modern psychology to anthropology. Numerous examples were adduced to illustrate the connection between psychic and physical action, modern psychology beginning with a study of sensation rather than movement. The law of Fechner and Weber, that if stimuli increase in arithmetical proportion, sensation will increase in geometrical proportion, was, although repudiated by physiologists generally, held by the speaker as furnishing an index of discrimination and indicating methods by which we can distinguish and measure individual responsiveness to various stimuli. Devices for registering and measuring psychical responsiveness were described.

The subjects of psycho-neural tests, temperaments and the effects of stimuli on unconscious movement were discussed by Messrs. Kavanaugh, Mills, Allen, Witmer and Reisman.

Botanical Section, April 13. Dr. Charles Schaeffer, Recorder. Mr. Lippincott presented a specimen of *Grindelia squamosa*, a Western plant, collected at Swedesboro', N. J. He also read a paper on the propagation of orchids.

A paper on the varieties of bacteria, their cultivation and their life history was read by Dr. Rabinowitsch.

Dr. Ida Keller exhibited the effect of chlorine in changing the blue color of a *Cinneraria* to pink due to the formation of hydro-chloric acid in the petals. The experiment was made in connection with a consideration of the acid or alkaline contents of vegetable cells.

EDW. J. NOLAN,
Recording Secretary.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, APRIL 7, 1896.

Ice Phenomena in Green Bay, Lake Michigan. By E. P. CAREY.

The Great Lakes offer an interesting field for the study of ice action under the influence of the wind, especially at the head of Lake Superior in the vicinity of Duluth, and in Green

Bay, at the west of Lake Michigan, from which it is almost entirely shut off except a very narrow strait called the 'door.'

At these two localities the effects are quite different. Mr. D. J. Woolman, of Duluth, states that at the head of Lake Superior the ice, which has formed in early winter some distance out from the shore, usually soon becomes broken up by easterly or westerly winds and is subsequently piled up by the wind in a ridge several feet high along the shore. In later winter the ice freezes more deeply and so becomes frozen to the bottom for some distance out from the shore. Beyond this limit of freezing the outer ice again becomes broken up by the wind, and in a similar way another ridge of ice is formed a few rods from the shore, roughly parallel with the first ridge, and enclosing a sheet of smooth ice. In this way two or more ridges of ice are formed parallel with the shore.

In Green Bay, however, the effect is quite different. The Bay is almost entirely shut off from Lake Michigan and in winter becomes entirely frozen over, and after once freezing over the ice is rarely broken up to any extent by the wind. On the other hand, a strong wind from the west or northwest sometimes has the effect of causing the ice to move shoreward in the direction of the wind, as a solid sheet, thus piling it up along the shore to a depth of sometimes sixty feet or more. A movement of this kind generally occurs at least once during a winter, and is fully accomplished in from *one* to *three* minutes.

In this way considerable geological work is done along the shore, and it is not uncommon to see, after the ice melts in spring, a pile of shore debris piled up in places to a height of eight feet, and showing features characteristic of moraines. The amount of geological work done at different points along the shore differs and at any point seems rather to depend on the slope of the shore and conditions other than the ice movement at that point, *e. g.*, at the point where the maximum amount of ice movement occurred the minimum amount of work was done. Here the conditions were these, viz: A steep slope just at the shore line, which must have had the effect of causing the ice to break almost as soon as it began to move. Along the shore about eight feet from the original ice front, stood a pile of slabs, piled loosely to a height of ten feet, and parallel with the shore so as to directly oppose the advance of the ice. These slabs, however, though completely buried for many feet by the ice which pushed up over and beyond them, were nevertheless scarcely disturbed. As the ice became broken at the shore line the pieces filled in between the shore and the slabs so that the ice following pushed up over the ice already deposited there, leaving the slabs practically intact.

T. A. Jaggar, Jr.,
Recording Secretary.

PROCEEDINGS OF THE TORREY BOTANICAL CLUB.

The Club met on Tuesday evening, April 9, 1896, President Addison Brown in the chair, and 30 persons present. Two new members were elected.

Dr. Albert Schneider read a paper on 'The Uses of Lichens,' giving an instructive account of the past and present uses of these plants in medicine and the arts. Mr. P. A. Rydberg read his announced paper entitled 'Preliminary Notes on a Revision of the North American species of *Potentilla* and Related Genera.' This was accompanied by many herbarium specimens and drawings, and drew forth remarks from the President and Mrs. Britton.

The last paper was that of Mrs. E. G. Britton, on 'Notes on Mexican Mosses.' Mrs. Britton gave a short historical account of the various collections of mosses which have been made in Mexico, stating that she had recently received, for naming, the specimens gathered by Pringle, as well as those collected in 1892 by Smith and Brunner. Specimens from these two collections, as well as others from those of F. Müller, C. Mohr, Hahn, etc., were exhibited, and a comparison was made of the number of genera and species which are common to Mexico and the United States.

The President reminded the members of the first Field Day of the season, April 25th, at Prince's Bay, S. I.

W. A. Bastedo,
Secretary pro tem.

SCIENCE

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SCIENCE

FRIDAY, MAY 15, 1896.

CONTENTS:

SOME PROBLEMS ABOUT TO CONFRONT ASTRONOMERS OF THE TWENTIETH CENTURY.

Members of the New York Academy of Sciences, Ladies and Gentlemen: The nineteenth century has shown vigorous development in all branches of science, and in none more than in astronomy. The effective work of numerous observers and mathematicians has lifted us to greater heights of knowledge, making visible and clear many things previously discerned dimly. But the elevation has also extended our horizon, and the boundaries of knowledge appear 'infinitely infinite.' This evening I shall not make any attempt to sketch the details, or even the general features of the view before us, as we stand at the end of the century, looking down from the elevated position the scientific workers in astronomy enable us to occupy. I shall content myself with a much narrower survey, selecting here and there some especial part of the field before us, with the desire of stating briefly what has been done in that field and in what condition it now stands.

From the point of view of the practical astronomer the stars are so many signal lights marking the 'milestones on the great celestial highway traversed by the planets, as well as on the byways of space occasionally pursued by comets.' If we desire to know the position of a planet or a comet on

*Address of the retiring President of the New York Academy of Sciences, March 30, 1896.

the celestial vault, we must observe how far such a body is separated in two directions from the neighboring stars, and evidently we must know where these stars are situated in the heavens. A few thousand stars are sufficient for this purpose provided they are determined in position with the highest precision.

But the astronomer is also deeply interested in 'the sublime problem of the construction of the heavens' and many thousands of stars must be exactly located to aid in solving this problem. Moreover, there is need of a general rollcall of all the stars visible in ordinary telescopes. Such a 'rollcall' or 'index' gives the positions of the stars with an accuracy less than the highest precision requires, and is mainly useful as a basis of work for the more accurate catalogues. The work of determining the positions of stars on the sky-dome is the most important and fundamental operation in practical astronomy. During the present century this foundation work of astronomy has been carried on 'with a zeal and success by which all previous efforts are dwarfed into insignificance.'

The great German astronomer 'the unrivalled Bessel' from 1821 to 1833 made some 75,000 observations, by which the number of fairly well determined stars was increased to above 50,000. His assistant and successor, Argelander, who gave up finance for astronomy, using a glass only two and a half inches in diameter, recorded 324,189 stars down to the $9\frac{1}{2}$ magnitude. This number included all the stars of the magnitude named, visible in the northern hemisphere of the heavens, and in addition a small zone about two degrees wide, south of the celestial equator. Schönfeld continued the survey at Bonn, down to the southern tropic.

In 1882 a photograph taken of the great comet of that year, by Dr. Gill at the Royal Observatory at the Cape of Good Hope, showed so many stars that it was determined to use photography in completing the Bonn survey to the south pole. The exposure of the plates in duplicate required four years from 1885–89. But this was the least laborious part of the great work. These plates had to be measured and the measurements reduced so as to obtain the proper positions of the stars on the sky. Prof. Kapteyn, of Gröningen, lately completed this task, and the catalogue from the plates is now passing through the press. The catalogue will contain about 350,000 stars to the tenth magnitude. A considerable part of the southern sky covered by the surveys of Schönfeld and Gill was examined also by Dr. Gould. Through 'unceasing labors during his fifteen years' residence a Cordoba,' in the Argentine Republic, an acquaintance of some 73,160 stars down to the $9\frac{1}{2}$ magnitude was brought about. The Argentine General Catalogue was published in 1886 and contained the accurate places of 32,448 southern stars. These and other catalogues put us in possession of a list of stars fairly well determined in position, numbering nearly 700,000. Catalogues of much greater precision, giving the positions of a smaller number of stars with the highest accuracy, have been prepared after many years of observation and calculation by the noted observatories of the world.

As an example of coöperation in modern science, I ought to mention that the first organized effort for determining star positions with the highest precision was made by the German Astronomical Society in 1865. The scheme, now practically finished, was to fix the positions accurately of about 100,000 stars on Argelander's list and some 30,000 from Schönfeld's. Thirteen observatories were interested in this great work, each being assigned a 'zone;' two in this country—Harvard College Observatory and the Dudley Observatory at Albany.

The work of Lewis M. Rutherfurd, of this city, an honored member of this Academy for many years, in photographing stellar clusters and in measuring the plates with a machine of his own devising, was the first serious attempt to use photography in getting the exact relations of stars to each other. The recent publications of the Columbia College Observatory show unmistakably that from these measures relative positions of the highest precision are obtainable. The invention of dry plate photography has made the photographic work of the astronomer of to-day much more expeditious, and enables him to secure many more stars on his plates with a given time of exposure. The last years of this century witness the carrying out of a gigantic plan for making an enormous catalogue of the highest precision by the aid of photography and supplementing this catalogue by a series of charts.

On April 16, 1887, there met in Paris 56 delegates of 17 different countries, to discuss ways and means of carrying out this grand photographic work. The final decision was to construct a photographic chart of the heavens of all the stars down to the 14th magnitude. On these plates will appear, it is estimated, some 20,000,000 stars. Methods are now being devised to reproduce accurately these chart plates. It was decided also to supplement these chart plates, made with an exposure of 40 minutes, by plates of shorter exposures, from measurements of which, with machines of the highest precision, a catalogue is to be prepared. These catalogue plates show the stars down to the 11th magnitude, and the number of stars may reach two millions. Twenty-two thousand plates (duplicated and overlapping) will be necessary for the catalogue. The work has been going on for several years at 18 observatories throughout the world (except in the United States) and the photographic part will soon be finished. The measurements of the plates and the calculations based thereon are also being carried on at Paris, Potsdam, Greenwich and elsewhere. Judging from the work already done, we may confidently expect that nearly all the results will be ready for printing in about ten years. The astronomers of the 20th century will then be in possession of material which will aid them in studying the problems connected with the construction of the universe of stars.

The number of stars around us increases with every augmentation in telescopic power, and in time of exposure of photographic plates. The largest telescopes will show perhaps more than 60,000,000 stars. The long exposure photographs (say 12 hours) would show many millions more. M. l'Hermite has 'computed the population of the stellar universe from his valuation of stellar light power and finds it, on the assumption that the scattering of the stars is everywhere just as it is in our own neighborhood, to be sixty-six thousand millions!' This result is ingenious and interesting, but depends for its value on the above assumption.

The task of sidereal astronomy—a stupendous one—is this then: 'to investigate the nature, origin and relationships of millions of stars; to inquire into their movements among themselves and that of our sun among them,' and 'to assign to each its place and rank in the universal order.'

Among the great number of interesting problems in sidereal astronomy, let me select two or three of the most important. The catalogues of the highest precision enable the astronomer to determine the positions of various stars at widely different dates. This requires that the catalogues used should be made up from observations at those dates. Now comparing the positions of a star at any two dates a difference will be found depending in amount on the lapse of time. The star, therefore, has apparently moved from the first to the second position. But there are several things to be taken into account before we can say how much the star has moved. The effects of precession and nutation and the aberration of light must be eliminated. When this is done it is found that only a very few stars have an accurrately determined motion of their own among their fellows. Schönfeld, of Bonn, has published a list of 83 stars that have a proper motion in a year greater than 1″ of arc, *i. e.*, greater than the angle subtended by three-tenths of an inch to the eye placed one mile away. Only 83 of all the hosts of stars are known to move at right angles to our line of sight 1″ of arc or more in one year.

The star which has the greatest proper motion so far known is No. 1830 of Groombridge's Catalogue. This star moves 7″ of arc in a year. The star is so far away that this small apparent motion across our line of sight means, if the distance has been accurately determined, a very startling linear velocity of more than 230 miles in a second, a speed 'uncontrolable, according to Newcomb, by the combined attractive power of the entire sidereal universe.'

Groombridge 1830 is not the only 'runaway' star in the list, there are several others; Clerke remarks "the fact then confronts us that not a few of the stars possess velocities transcending the power of government of the visible sidereal system. Is that system threatened with dissolution, or must we suppose the chief part of its attractive energy to reside in bodies unseen, because destitute of the faculty of luminous radiation? No answer is possible; conjecture is futile. We are only sure that what we can feebly trace is but a part of a mighty whole, and that on every side our imperfect knowledge is compassed about by the mystery of the Infinite."

When we consider proper motions less in amount than 1″ a year the list swells in number to over 3,000. The astronomer of the XXth Century will be able to determine the proper motions of thousands of other stars, using the superb catalogues constructed in this century. In studying this problem the aid of the spectroscope has been called in, and with that wonderful instrument it has been found possible to measure the velocity of quite a number of stars in the line of sight, either directly from us or toward us. At Potsdam and at Greenwich and elsewhere, by the use of measurements or photographs of stellar spectra or by visual observations, Aldebaran, the brighest star in the constellation of Taurus, has been found to be moving from the earth at the rate of 30 miles a second. The Greenwich observers tell us that the North Star is moving toward us at the rate of 16 miles a second. Vogel, at Potsdam, places the motion of Arcturus at 45 miles a second from the earth. When we combine the motion in the line of sight with the motion at right angles to that line, we can discover the real motion in space, its amount and direction. At the Lick Observatory Mr. Campbell has proposed to determine with the spectroscope in what direction the solar system is moving among the stars.

The motion of our solar system among the stars has interested astronomers for many years. Sir Wm. Herschel first investigated this problem a century ago. The fundamental principle of the investigation is this: Those stars which lie in the direction in which we are going will appear to open out from each other, while those in the part of the sky that we are leaving will close up behind us. Since Herschel's time the materials for investigation have been greatly augmented. An examination of the stellar proper motions has been made by many calculators, and especially recently by Prof. Boss, of Albany, and by Mr. Oscar

Stumpe, of Bonn. The results agree as well as we could expect at present in fixing 'the brilliant Vega' as 'the center round which the new determined apexes tend loosely to group themselves.' The general direction of the solar motion is thus fairly well determined. The velocity of this motion has not yet been accurately worked out. Sixteen miles a second is given by some astronomers as a probable value.

The distances of the stars have always excited the curiosity of man. During this century the refined methods for obtaining reliable values have been worked out. Only within the last twenty years have the most accurate values been determined. The solar system to our finite minds seems isolated in space, the *nearest star* being so far away that light traveling at the rate of 186,330 miles in each second of time consumes 4.35 years in reaching the earth. The parallax of α Centauri is 0."75, *i. e.*, the distance separating the earth from the sun, over 90,000,000 miles, would appear to the eye of an observer on α Centauri, as small as $\frac{2}{10}$ of an inch appears to our eyes at a distance of one mile. This nearest star, α Centauri, is at the head of a list of less than 60 stars whose parallaxes have been determined with all the accuracy, very nearly, at present possible. But the laborious search for measurable stellar parallaxes has not been extensive enough among the millions of stars to make us feel that astronomers have determined certainly even the nearest star. Perhaps it will be found among some of the fainter telescopic stars, or even on the photographic plates, that with long exposure show us stars so faint that we can never expect to see them. Photography has proved itself to be a most valuable aid in this investigation, and from the plates specially made much more is to be expected in the future.

The telescope shows numerous cases in which two stars are so close to each other that they can be separated only by a high magnifying power. These are 'double stars.' The catalogues now enumerate more than 10,000 such couples, and the number known to us is increasing quite rapidly. One of the chief pieces of work in which the largest telescopes are used is in detecting new cases of very faint and exceedingly close doubles. A careful examination has revealed the fact that some 200 or more cases of double stars show that the components are physically connected.

The components revolve about the common center of gravity of the system. When one of the stars is much greater in mass than the other, the second star, usually the fainter, revolves about the larger one. Many of these binary stars as they are called are of great interest. Their times of revolution range from 14 years to 1,500 years. The orbits are comparable with the larger orbits of the solar system, some of them being twice as large as that of the planet Neptune, which, as you will remember, moves in an orbit having a radius of about 2,800,000,000 of miles, and revolves about our sun in 165 years nearly.

There are cases of multiple stars. Epsilon Lyrae is a beautiful quadruple star, composed of two pairs. Each pair makes a slow revolution in a period of over 200 years. It is thought that there is evidence that the two pairs revolve about the common center of gravity of the four stars.

Peters found in 1851 that the apparent irregularities in the movements of the brilliant Dog star Sirius could be fully explained by an orbital revolution in a period of fifty years. Bessel had announced in 1844 that the two bright Dog stars Procyon and Sirius moved in seeming irregular paths, because of the presence of unseen bodies near them. Peters thus vindicated Bessel's prediction. On the 31st of January, 1862, while testing the new 18-inch object glass ordered by the late Pres. Barnard for the University of Mississippi, Alvan G. Clark discovered a faint companion to Sirius. This proved to be in the exact position required by Peters' calculations. For Procyon no companion has been found. Recently there have been found evidences of an unseen body in the system of 70 Ophiuchi, a wide double. These and similar investigations indicate that there may be myriads of systems in space similar to our own. Painstaking observations and exact calculations will, no doubt, reveal many hundreds of these systems during the next century, even before new inventions have increased our seeing power.

The thoughtful observer is struck by the fact that the light of most of the stars does not appear to change; they remain each of them apparently of the same brightness year after year, and so far as we can judge from previous accounts, century after century. The stars are so far away that changes in their light-giving power are in most cases invisible to us. There are, however, now known nearly 400 stars which show a variation in light. Some stars change their brightness slowly and continuously; others fluctuate irregularly, like the wonderful star η Argus in the southern heavens, which was nearly as bright as Sirius in 1843 and decreased in brightness down to the 7th magnitude in 1865. It remained at that magnitude until 1888 and has since been increasing in brightness. Dr. Gill, at the Cape of Good Hope, has been studying the star by the aid of photography during the past few years.

Then there is a class of variables called 'temporary stars.' These blaze out suddenly and then disappear. Such variables are styled, sometimes, 'new stars.' Pickering gives a list of 14 'new stars' discovered since the time of Tycho Brahe in 1572. In this list all but four belong to this century, no temporary star being recorded between 1670 and 1848. Six new stars are recorded as having been discovered since 1886. Two of these in 1895. There is no doubt that a more careful study of the heavens will reveal many more such cases. Several of the stars of this class were brightly visible to the naked eye. They remained visible with fading light for different periods of time. Future investigation may show that these stars will appear again, and thus indicate that they are variables of long period showing such light changes as to place their minima beyond the power of the telescope or even of the photographic plate. Then there are known to be a considerable number of variables whose periods of light changes are well determined. These are most interesting to observe. One class has a period of several months, another class a period which is quite short, and still another class 'in which the variation is like what might be produced if the star were periodically eclipsed by some intervening object.' Great use is now made of photography both of the stars and of their spectra in studying variables. At the Harvard College Observatory the plates taken in Arequipa, Peru, have shown on examination many variables. Pickering states that in two photographs of the cluster Messier 5 taken August 9, 1895, only two hours apart, forty-six variables of short periods were found! In the photographs of stellar spectra the presence of bright hydrogen lines in conjunction with dark lines or dusky bands has led to the discovery of numerous variables. The subject is of growing interest and the further prosecution of the work will add, no doubt, many thousands to the present list which has recently been brought down to date by Dr. S. C. Chandler, of Cambridge.

The study of the sidereal systems presents many problems for the mathematical astronomer, but let us consider some unsolved problems connected with our own system. "The profoundest question growing out of the theory of gravitation is whether all the inequalities in the motion of the moon and the planets admit of being calculated from their mutual attraction." In order to answer the question the astronomer must make the calculations demanded by theory, giving him the positions of the planets considered, and then compare the calculated with the observed place. No complete solution has ever been found even in the case of three bodies, and for the case of a larger number of planets no approximation to an entire solution has been made. The complexity of the problem is due to the fact that "the forces which act upon the planets are dependent upon their motions, and these again are determined by the forces which act on them."

Many great mathematicians from Newton's time till now have given much of their attention to the question of how to surmount the difficulties. The success of the partial solution is attested by the "marvellous accuracy with which sun, moon and planets move in their prescribed orbits." Though the accuracy *is* marvellous, there are two cases of greatest interest especially demanding the attention of the mathematical astronomers. These two cases have to do with the motions of the Moon and of Mercury.

The 'Tables of the Moon,' calculated by Hansen and published in 1857 by the British government, were supposed to provide the astronomer with the means of calculating accurately the position of the moon for a century or more. Prof. Grant, in his 'History of Physical Astronomy,' published in 1852, remarked: "Thus the clouds which for a moment obscured the Newtonian theory of gravitation have been effectually dissipated, and a fresh conquest has been added to the long list of triumphs which adorn its history." The agreement of observed and calculated position from 1750 to 1850 is all that could be desired, but it has been found that previous to 1750 and after 1850 the calculations and observations do not agree closely enough to satisfy the mathematical astronomer. Mr. Stone, of Oxford, has published a table (M. N. R. A. S., LII., No. 7, p. 478) showing the 'mean excess over observation of the moon's tabular place in longitude for the years 1847 to 1891, as computed from Hansen's tables.' It is therein shown that from 1847 to 1863 the calculated longitude differed from the observed by a mean annual value of —1″.85 and no law of regular change is apparent. Since 1863 the mean annual error has increased at an average rate of 0″.75 per annum. The error now amounts to about 20″, equal to about $\frac{1}{100}$ of the moon's angular diameter.

The lunar tables have been empirically corrected by Newcomb and also by Tisserand and at present the results are satisfactory. However, gravitation seems unable to explain theoretically the movement of the moon's perigee. The mathematical astronomer will no doubt triumph over the new obstacle which presents itself to-day, but, as Tisserand says, a beautiful discovery remains to be made.

Newcomb has stated that "another change not entirely accounted for on the theory of gravitation occurs in the motion of the planet Mercury." Leverrier found "that the motion of the perihelion of Mercury is about 40″ in a century greater than that computed from the gravitation of the other planets." He attributed this to the attraction of a 'group of small planets between Mercury and the sun.' Newcomb, in his recent work on 'Astronomical Constants,' gives the result of an examination of this hypothesis as well as of several others. He concludes (1) "that there can be no such non-symmetrical distribution of matter in the interior of the sun as would produce the observed effect." (2) The hypothesis of an intra-mercurial ring or group of planetoids seems to be untenable. (3) The hypothesis of an extended mass of diffused matter like that which reflects the zodiacal light has insurmountable difficulties. (4) The hypothesis of a ring of planetoids between the orbits of Mercury and Venus is very unsatisfactory.

Newcomb finally regards Prof. Hall's hypothesis as not inadmissible. This hypothesis is a startling one, no less than that gravitation toward the sun is not exactly as the inverse square of the distance. Prof. Paul Harzer has recently published a memoir dealing with this subject, which obtained the prize of the Jablonowski Society. Harzer is disposed to attribute the greater motion of Mercury's perihelion to an irregular distribution of the sun's mass within its surface, admitted to be spherical; being denser in the parts near the solar equator. He appears to think the solar corona may have something to do with it. Harzer's theory seems to have the advantage over Newcomb's modification of Newton's law in that it leaves the latter intact.

Newcomb considers that, with the exception of the motions of the moon and of Mercury, "all the motions in the solar system, as far as known, agree perfectly with the results of the theory of gravitation. The little imperfections which still exist in the astronomical tables seem to proceed mainly from errors in the data from which the mathematicians must start in computing the motion of any planet. The time of revolution of a planet, the eccentricity of its orbit, the position of its perihelion, and its place in the orbit at a given time, can none of them be computed from the theory of gravitation, but must be derived from observations alone. If the observations were absolutely perfect, results of any degree of accuracy could be obtained from them; but the imperfections of all instruments and even of the human sight itself prevents observations from attaining the degree of precision sought after by the theoretical astronomer and make the consideration of 'errors of observation' as well as 'errors of the tables' constantly necessary."

One of the most important and interesting investigations going on now deals with the subject of variation of latitude. Certain theoretical considerations led the astronomers fifty years ago to look for changes of latitude which showed a period of 305 days. Maxwell and Bessel examined the matter and Bessel found that his latitude diminished $0''.3$ in two years (1842). Other observations at various places showed aparent changes of small amounts. The results for several reasons that then appeared sound were not regarded as satisfactory, so that it was doubted by many that any measurable variation of latitude would be found. The problem assumed a new aspect, however, when Dr. Küstner, of Berlin, published the results of his observations made in 1884–85. These results showed unmistakably that a small but quite a rapid change had occurred in the latitude of Berlin, amounting to from $0''.2$ to $0''.3$. The examination of other observations showed similar results.

A crucial test was made by sending an expedition to the Sandwich Islands, which is 180 degrees (nearly) in longitude from Berlin. If, it was known, the latitude of Berlin increased, then a point in the northern hemisphere, 180 degrees away from Berlin, should simultaneously show a decrease in latitude, for if the pole moves toward Berlin it must move from the point on the other side of the earth. Our own government joined in the effort. Marcuse, of Berlin, and Preston, of Washington, spent more than a year on the Sandwich Islands observing for latitude, while at the same time observations were continued at Berlin, Prague and Strasburg, in Europe, and at Bethlehem, Rockville and San Francisco, in the United States. The results of all these observations have been published and show, without a chance of error, that the earth's axis is moving, that the latitudes at the Sandwich Islands increased when the latitudes in Germany diminished and *vice versa*.

The law of the change was eagerly and industriously sought for by some of the ablest mathematical astronomers of the world. They first worked on the idea that the changes must conform to the 305-day period of Euler, combined with an annual change due to causes set forth by Sir W. Thompson. None of these investigations gave any satisfactory formulas for the prediction of the latitude of a place. In 1891 Dr. S. C. Chandler of Cambridge, Mass., began his investigations of the problem. He remarks:

"I deliberately put aside all teaching of theory, because it seemed to me high time that the facts should be examined by a purely inductive process; that the nugatory results of all attempts to detect the existence of the Eulerian period (of 305 days) probably arose from a defect in the theory itself; and that the entangled condition of the whole subject required that it should be examined afresh by processes unfettered by any preconceived notions whatever. The problem which I therefore proposed to myself was to see whether it would not be possible to lay the numerous ghosts in the shape of the various discordant, residual phenomena pertaining to determinations of aberration, parallaxes, latitudes and the like, which have heretofore flitted elusively about the astronomy of precision during the century; or to reduce them to some tangible form by some simple, consistent hypothesis. * * * It was thought that if this could be done, a study of the nature of the forces are thus indicated, by which the earth's rotation is influenced, might tend to a physical explanation of them."

Dr. Chandler examined a great mass of observations, new and old, and from their discussion has obtained a formula which at the present time expresses very well the changes of latitude at any place at any epoch. For his excellent and laborious work of several years, Dr. Chandler has received medals from our National Academy and the Royal Astronomical Society of London.

The result of Dr. Chandler's investigation show that the pole of the axis of rotation of the earth may be considered as revolving from west to east in a circle with a radius of about 14 feet, with an average period of 428.6 days. The center of this circle moves from west to east around the circumference of an ellipse in about a year. The pole of the axis of figure is at the center of this ellipse. Evidences of still greater complexity in the motion of the pole seem to be exhibited by Dr. Chandler's analysis. These motions combining make the actual path of the pole sometimes the arc of an ellipse, at times a circular arc and then again almost a straight line. At times the various changes conspire to give a maximum of $''.33$, and at others the minimum separation of few hundredths of a second of the pole of rotation from the pole of figure.

During the year 1895 Chandler's formula makes the pole move nearly parallel with our meridian. This would produce observable changes of latitude here, but none at places 90 degrees east (in Europe) or west of us. To thoroughly test the formula observations must be kept up for many years at various places on the earth's surface.

The International Geodetic Association propose the establishment of four observatories on the same parallel of latitude: in Japan, Sicily, Virginia and California. At these places it is suggested that photographic observations be kept up for many years, so that more exact data can be obtained for calculating, if possible, a more exact formula. No adequate theoretical explanation has been found, as yet, of the observed variations, though it is suspected that the annual part of the variation is due to meteorological causes, and that the other part may be caused by changes in the relative positions of portions of the earth's mass, such as movements of great masses of water and depositions of ice and snow.

A number of important problems are involved in this question of latitude variation. All the determinations of astronomy have been made on the assumption that our latitudes do not change. When the astronomer is supplied with sufficiently exact data the determination of various constants used in astronomy must be recalculated. Dr. Chandler and others have already begun the reinvestigation.

The problems so far discussed belong to pure astronomy. In the past forty years there has grown up, with a vigorous growth, a new branch of astronomy styled by some The New Astronomy. This branch deals with the beautiful and interesting investigations of the heavenly bodies made by the aid of that wonderful instrument of modern research, the spectroscope. On this occasion I will not trespass on your patience by attempting to describe to you the achievements of the new astronomy in the examination of the sun and the planets, the stars, nebulæ and comets. By the investigations of this young science of spectroscopy applied to the heavenly bodies, we get our first and accurate ideas of their constitution. On the spectroscopist we must depend for our knowledge of the surroundings of the sun and planets—the materials entering into the make-up of the stars, comets and nebulæ. The study of the stellar spectra brings wonderful information in regard to variable stars and the motions of stars.

The discoveries of argon and helium have unlocked some doors to knowledge previously closed tightly. On astrophysics the astronomer of the 20th century must depend for solving many problems. It is likely that a study of planetary spectra will give us the means of determining the rotation times of the planets—Venus and Mercury.

We have thus briefly and inadequately mentioned some of the problems which the astronomer of the next century must deal with. When we consider the progress made during the past twenty-years only, we are led to believe that world-wide coöperation in astronomical work will be one of the great features of the coming century. Only by such coöperation, directed by the ablest astronomers, can the most effective work be done. With such coöperation many of the troublesome problems will undoubtedly be solved.

J. K. REES.

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*A NEW FORM OF RADIATION.**

As my investigations will have to be interrupted for several weeks, I propose in the following paper to communicate a few new results.

§ 18. At the time of my first communication it was known to me that X-rays were able to discharge electrified bodies, and I suspected that it was X-rays, not the unaltered cathode rays, which got through his aluminum window, that Lenard had to do with in connection with distant electrified bodies. When I published my researches, however, I decided to wait until I could communicate unexceptionable results. Such are only obtainable when one makes the observation in a space which is not only completely protected against the electrostatic influences of the vacuum tube, leading-in wires, induction coil, etc., but which is also protected against the air coming from the

*Second communication to the Würzburg Physico-Medical Society. Reprinted from the translation in *Electricity*.

vicinity of the discharge apparatus. To this end I made a box of soldered sheet zinc large enough to receive me and the necessary apparatus, and which, even to an opening which could be closed by a zinc door, was quite air-tight. The wall opposite the door was almost covered with lead. Near one of the discharge apparatus placed outside, the lead-covered zinc wall was provided with a slot 4 cm. wide, and the opening was then hermetically closed with a thin aluminum sheet. Through this window the X-rays could come into the observation box. I have observed the following phenomena:

(*a*) Positively or negatively electrified bodies in air are discharged when placed in the path of X-rays, and the more quickly the more powerful the rays. The intensity of the rays was estimated by their effect on a fluorescent screen or on a photographic plate. It is the same whether the electrified bodies are conductors or insulators. Up to the present I have discovered no specific difference in the behavior of different bodies with regard to the rate of discharge, and the same remark applies to the behavior of positive and negative electricity. Nevertheless, it is not impossible that small differences exist.

(*b*) If an electrical conductor is surrounded by a solid insulator, such as paraffin, instead of by air, the radiation acts as if the insulating envelope were swept by a flame connected to earth.

(*c*) If this insulating envelope is closely surrounded by a conductor connected to earth, which should like the insulator be transparent to X-rays, the radiation, with the means at my disposal, apparently no longer acts on the inner electrified conductor.

(*d*) The observations described in *a*, *b* and *c* tend to show that air traversed by X-rays possesses the property of discharging electrified bodies with which it comes in contact.

(*e*) If this be really the case, and if, further, the air retains this property for some time after the X-rays have been extinguished, it must be possible to discharge electrified bodies by such air, although the bodies themselves are not in the path of the rays.

It is possible to convince oneself in various ways that this actually happens. I will describe one arrangement, perhaps not the simplest possible. I employed a brass tube 3 cm. in diameter and 45 cm. long. A few centimeters from one end a portion of the tube was cut away and replaced by a thin sheet of aluminum. At the other end an insulated brass ball fastened to a metal rod was led into the tube through an air-tight gland. Between the ball and the closed end of the tube a side tube was soldered on, which could be placed in communication with an aspirator. When the aspirator was worked the brass ball was surrounded by air, which on its way through the tube went past the aluminum window. The distance from the window to the ball was over 20 cm. I arranged the tube in the zinc box in such a manner that the X-rays passed through the aluminum window at right angles to the axis of the tube, so that the insulated ball was beyond the reach of the rays in the shadow. The tube and the zinc box were connected together; the ball was connected to a Hankel electroscope. It was seen that a charge (positive or negative) communicated to the ball was not affected by the X-rays so long as the air in the tube was at rest, but that the charge immediately diminished considerably when the aspirator caused the air traversed by the rays to stream past the ball. If the ball by being connected to accumulators was kept at a constant potential, and if air which had been traversed by the rays was sucked through the tube, an electric current was started as if the ball had been connected with the wall of the tube by a bad conductor.

(*f*) It may be asked in what way the air loses this property communicated to it by the X-rays. Whether it loses it as time goes on, without coming into contact with other bodies, is still doubtful. It is quite certain, on the other hand, that a short disturbance of the air by a body of large surface, which need not be electrified, can render the air inoperative. If one pushes, for example, a sufficiently thick plug of cotton wool so far into the tube that the air which has been traversed by the rays must stream through the cotton wool before it reaches the ball, the charge of the ball remains unchanged when suction is commenced. If the plug is placed exactly in front of the aluminum window the result is the same as if there were no cotton wool, a proof that dust particles are not the cause of the observed discharge. Wire gauze acts in the same way as cotton wool, but the meshes must be very small and several layers must be placed one over the other if we want the air to be active. If the nets are not connected to earth, as heretofore, but connected to a constant-potential source of electricity, I have always observed what I expected ; however, these investigations are not concluded.

(*g*) If the electrified bodies are placed in dry hydrogen instead of air they are equally well discharged. The discharge in hydrogen seems to me somewhat slower. This observation is not, however, very reliable, on account of the difficulty of securing equally powerful X-rays in successive experiments. The method of filling the apparatus with hydrogen precluded the possibility of the thin layer of air which clings to the surface of the bodies at the commencement playing an appreciable part in connection with the discharge.

(*h*) In highly-exhausted vessels the discharge of a body in the path of the X-rays takes place far more slowly—in one case it was, for instance, 70 times more slowly—than in the same vessels when filled with air or hydrogen at atmospheric pressure.

(*i*) Experiments on the behavior of a mixture of chlorine and hydrogen, when under the influence of the X-rays, have been commenced.

(*j*) Finally, I should like to mention that the results of the investigations on the discharging property of the X-rays, in which the influence of the surrounding gases was not taken into account, should be for the most part accepted with reserve.

§ 19. In many cases it is of advantage to put in circuit between the X-ray producer and the Ruhmkorff coil a Tesla condenser and transformer. This arrangement has the following advantages: Firstly, the discharge apparatus gets less hot, and there is less probability of its being pierced; secondly, the vacuum lasts longer, at least this was the case with my apparatus; and thirdly, the apparatus produces stronger X-rays. In apparatus which was either not sufficiently or too highly exhausted to allow the Ruhmkorff coil alone to work well, the use of a Tesla transformer was of great advantage.

The question now arises—and I may be permitted to mention it here, though I am at present not in a position to give answer to it—whether it be possible to generate X-rays by means of a continuous discharge at a constant discharge potential, or whether oscillations of the potential are invariably necessary for their production.

§ 20. In § 13 of my first communication it was stated that X-rays not only originate in glass, but also in aluminum. Continuing my researches in this direction, I have found no solid bodies incapable of generating X-rays under the influence of cathode rays. I know of no reason why liquids and gases should not behave in the same way.

Quantitative differences in the behavior of different bodies have, however, revealed themselves. If, for example, we let the cathode rays fall on a plate, one-half consisting of a 0.3 mm. sheet of platinum and the other half of a 1 mm. sheet of aluminum, a pin-hole photograph of this double plate will show that the sheet of platinum emits a far greater number of X-rays than does the aluminum sheet, this remark applying in either case to the side upon which the cathode rays impinge. From the reverse side of the platinum, however, practically no X-rays are emitted, but from the reverse side of the aluminum a relatively large number are radiated. It is easy to construct an explanation of this observation; still it is to be recommended that before so doing we should learn a little more about the characteristics of X-rays.

It must be mentioned, however, that this fact has a practical bearing. Judging by my experience up to now, platinum is the best for generating the most powerful X-rays. I used a few weeks ago, with excellent results, a discharge apparatus in which a concave mirror of aluminum acted as cathode and a sheet of platinum as anode, the platinum being at an angle of 45 deg. to the axis of the mirror and at the center of curvature.

§ 21. The X-rays in this apparatus start from the anode. I conclude from experiments with variously-shaped apparatus that as regards the intensity of the X-rays it is a matter of indifference whether or not the spot at which these rays are generated be the anode. With a special view to researches with alternate currents from a Tesla transformer, a discharge apparatus is being made in which both electrodes are concave aluminum mirrors, their axes being at right angles; at the common center of curvature there is a 'cathode-ray catching' sheet of platinum. As to the utility of this apparatus I will report further at a later date.

W. K. RÖNTGEN.

BEHAVIOR OF SUGAR TOWARDS RÖNTGEN RAYS.

THE fact that sugar is transparent to X-rays was ascertained at an early date after Röntgen's announcement of his momentous discovery. It seemed, however, of interest to learn whether the structure of the sugar traversed by the rays might exercise any influence on the rays or modify their action on photographic plates.

Through the courtesy of Prof. M. I. Pupin, of Columbia University, who kindly extended the privileges of his laboratory to the writer, the following tests were made:

Two plates of sugar were selected. The one was a disk 16 mm. thick, sawed from a titlar; a titlar is made by pouring a magma of best white refined sugar into a cone-shaped mould, washing well with pure white sugar liquor, and then baking the mass perfectly dry and hard. This disk was, therefore, practically a solid agglomeration of pure sucrose crystals. The other disk was made by dissolving perfectly pure white sugar in water, evaporating to a certain consistency, and then casting the mass in a copper ring. This disk also measured 16 mm. in thickness; it was a perfectly clear and transparent solid of a yellow color, and consisted of amorphous sugar-candy—so-called barley sugar.

A few preliminary trials were made by photographing with X-rays through these plates of sugar—with and without fluorescent screens—varying the time of exposure, etc. Finally, the following experiment was carried out.

A photographic plate was placed in a box, on the outside of which six metal disks were arranged in two groups of three each. Each group consisted of a medal of aluminium, provided with figures and inscriptions in bas-relief, a plain disk of aluminium and a silver quarter dollar.

One of these groups was covered with the crystalline, the other with the amorphous sugar plate. The Crookes tube was suspended $6\frac{1}{4}$ inches above the plates and an exposure of forty minutes was given.

The conditions under which the two sugar plates were placed were therefore identical and the results obtained comparable. On developing the photographic plate it was found that both sugar plates had permitted the X-rays to pass through sufficiently freely to form clear and well defined pictures of the metallic disks.

The figures and inscriptions on the aluminium medals were discernible in both instances, and the outlines of both the aluminium disks and of the silver coins were also well marked.

The negative, however, showed unmistakably that the amorphous sugar is more transparent to the X-rays than the crystalline modification. In the former case the background proved to have an even and darker hue, showing that X-rays had passed through freely and evenly. In the latter case the background was less dark and of a rather mottled appearance, in some places exhibiting apparently a faint outline tracing of the crystalline structure beneath which it had rested. This fact may be of interest in view of the mooted question concerning the power of diffusion and refraction of the X-rays.

In this connection it may not be amiss to also refer, briefly, to some tests made to ascertain whether or no the X-rays exercise any influence on polarized light. To this end a tube was made of aluminium, 200 mm. in length and 31 mm. in diameter; the walls were 2 mm. thick. This tube was filled successively with solutions of sucrose, dextrose, levulose and raffinose.

This tube with its contents was placed in a sugar polariscope; a ray of light was permitted to pass through the tube and the deviation of the polarized light produced by the solutions was noted. The polariscope with the filled tube was then placed underneath a Crookes tube in such a manner that the tube was directly in the path of maximum intensity of the X-rays, *i. e.*, in the path of the cathode rays, so that the rays would pass through the tube practically at right angles to the beam of polarized light which traversed the tube longitudinally.

The times of exposure given varied; seven minutes for the sucrose solution, ten minutes for the levulose and the raffinose solution and fifteen minutes for the dextrose solution, but in no instance was any deviation of the ray of polarized light noticeable. The polarization of the solutions were:

Sucrose,	+49.9
Raffinose,	+15.3
Dextrose,	+ 7.2
Levulose,	— 8.8

Of course these tests alone are not sufficient in number or kind to permit the drawing of any conclusive inference as to whether the X-rays influence the plane of polarized light or not, but they do establish the fact that, under the conditions under which these tests were made, no such influence was exerted. FERDINAND G. WIECHMANN.

THE X-RAYS IN MEDICINE AND SURGERY.

ON April 22d I succeeded in applying the X-rays to the diagnosis of disease in such a manner as to make it seem that a very wide field was open to medical as well as to surgical investigations by means of the X-ray.

Using a 'focussing' tube powerfully driven, I found it quite possible to cause calcium tungstate to fluoresce, even though a human trunk or head be interposed between the tube and the fluorescing screen.

Further, it became evident that the backbone, the ribs, the bones of the members, and the outline of the skull and of the upper portion, at least, of the pelvis could be plainly seen as shadows on the screen. The cartilaginous laminæ between the vertebræ could be distinguished. The heart could be seen in faint outline, being slightly more opaque than the lungs, which are very transparent. The liver is very opaque, and its rise and fall as the patient under examination breathed was very easily seen.

I was able to make a diagnosis of cases of tuberculosis, pneumonia, enlarged heart and enlarged spleen without difficulty. The outline of the heart was indicated by me and by Mr. Lawrence, who is working with me almost exactly as it had been mapped out by percussion, our greatest disagreement being about one-half an inch, the diameter of the heart being seven inches. An examination of some five seconds convinced us that a tuberculous patient was at least fairly sound on one side and very bad on the other, and this again agreed with the previous diagnosis at the hospital of which we, of course, were ignorant. The enlarged spleen could be outlined with great clearnesss, it being rather transparent, while the abdomen is ordinarily quite opaque.

A boy of three years, convalescent after an attack of pneumonia, was found to be transparent in that part of the lungs which had been diagnosed as 'clear,' and opaque in those portions which were shown by percussion to be still more or less filled up.

A buckle or a small pellet of lead is easily detected through any part of the body, except the lower part of the abdomen, and buttons and hooks and eyes are easily seen through the more transparent parts.

A patient was brought to us whose arm had been broken by a musket ball, and the exact location of the bullet was desired. After an examination of not more than a minute the bullet could be plainly seen. It had broken the ulna and then imbedded itself on the inner side of the radius about three inches nearer the shoulder. We marked the location of the bullet in two planes, and when the surgeons made an incision it was found that we were not in error by more than an eighth of an inch.

We have taken photographs by means of a Thomson high frequency coil in one-fifth of a second, as it seemed to be desirable to be able to work very rapidly to get photographs of such objects as do not remain fixed in position for any length of time.

The skull is not opaque, and the thicker and thinner positions can be distinguished, but of course no notion can be obtained of the texture of the brain. The detail of the lower jaw, its joint, the teeth, the filling in the teeth, and so on, can be clearly made out. The æsophagus is very transparent, and a foreign metallic body could hardly fail of detection unless well down in the lower part. The cartilaginous rings in the trachea, the glottis and epiglottis can be seen in fair outlines. Younger persons are more transparent than older, but show less differentiation, even the bones being quite transparent in a boy of ten. The brilliancy of the tube is increased many times by grounding the cathode.

CHAS. L. NORTON.
MASS. INSTITUTE OF TECHNOLOGY.

CURRENT NOTES ON PHYSIOGRAPHY.

DE LAPPARENT'S LEÇONS DE GÉOGRAPHIE PHYSIQUE.

THERE is no European text-book that has so fully caught what has come to be called the American method in physical geography or geomorphology, as de Lapparent's *Leçons de géographie physique* (Paris, Masson, 1896, 590 p.). Omitting other divisions of the subject, the whole volume is devoted to the physiography of the land. The work of denuding forces, acting on various initial land forms produced by uplift, deformation, volcanic accumulation or otherwise, is deliberately followed through the geographical cycle to its close in a peneplain of faint relief. Modifications of the general scheme of geographical development, due to movements with respect to baselevel, to glacial action, to wind action, and to subterranean waters, are considered in succession. These systematic chapters are followed by others in which an excellent outline of the physiography of Europe is presented, with briefer treatment of the other parts of the world. American readers who desire to cite European physiographic examples will find this book very helpful. It is illustrated with many diagrams and a good number of maps and views; its detailed table of contents hardly compensates for the absence of an index.

THE INTERIOR PLATEAU OF BRITISH COLUMBIA.

A recent report by Dr. G. M. Dawson on the area of the Kamloops map sheet in the interior of Columbia (Geol. Surv. Canada, Ann. Rept. vii., 1896) treats in more detail a portion of the region that the same author has previously described (Physiogr. Geol. of the Rocky Mountain region in Canada, Trans. Roy. Soc. Can., iii., 1890). Considered in a broad way, and in contrast to the mountains by which it is bordered, the interior region may be regarded as a plateau. Although deeply trenched by numerous valleys of late Pliocene date, these are lost to view when standing on the uplands, whose profiles run together to form a nearly horizontal sky line. The plateau is explained as a peneplain of subaërial denudation. It is enclosed on the west by the Coast range (not to be confused with the Coast range or the Cascade mountains of our Pacific slope), whose summits reach remarkably uniform altitudes of about 8,000 or 9,000 feet. This equality is explained as the result of the rapid consumption of any summits that may have formerly risen into greater altitudes, on the assumption that the progress of denudation in the partially snow-covered zone is several or many times greater than below it. This appears to be an interesting example of Penck's 'Oberes Denudationsniveau' (Morphologie der Erdoberfläche, ii., 164). A pronounced 'rain shadow' and chinook belt occur on the plateau district in the lee of these mountains. Interesting details are given concerning glacial action, lake basins, alluvial fans and terraces, and other features.

THE VOLCANIC GROUP OF TOPOGRAPHIC FORMS.

The chapter devoted to volcancos in most physical geographies is chiefly concerned with volcanic cones, so young as to be little worn. The more thorough study and classification of geographical forms, as primarily determined by structures and secondarily modified by sculpture, greatly extends the list of features associated with volcanic action, even including the products of those abortive attempts at eruption which have been blindly satisfied before reaching the surface. The buttes formed when these 'plutonic plugs' are revealed by denudation occur in fine variety of development and expression in the region of the Black hills of Dakota, and are described in the current number of the (Chicago) *Journal of Geology*, by Russell, with his customary appreciation of physiographic relations. A number of excellent photographs are reproduced as illustrations. The series of forms begins with Little Sun Dance dome, an arch of limestone, stripped of a great thickness of overlying weaker strata, but unbroken, even uncracked; the igneous rock not yet revealed. Mato Teepee, Inyan Kara and other imposing buttes are fully revealed plugs. The surrounding rims of harder stratified rocks offer interesting examples of outer slope and inface,* with inner subsequent valleys, all in concentric circular arrangement. One of the illustrations is a view looking outward

* The invention of this excellent term, the abbreviation of 'inward facing escarpment,' should be credited to Mr. L. C. Glenn, of Darlington, S. C.

along a radial consequent valley through a notch in a limestone rim.

LE TOUR DU MONDE.

THE illustrated weekly, published by Hachette & Co., Paris, under the above title supplies so many excellent illustrations well reproduced from photographs taken in various parts of the world, that it deserves mention as a contributor to physiographic knowledge. The volume for 1895 contains, among many others, a number of admirable pictures from the inner Sahara, portraying the escarpments, dunes and wadies with remarkable effect of glaring sunlight; of the lakes of Bavaria, both within and without the Alps; of tropical and polar scenes. The text is generally narrative and descriptive, with much about peoples and their customs, entertaining rather than strictly scientific; and some of the pictures bear evidence of touching up or even of invention by the too facile hand of the Parisian artist; but the volume as a whole is as instructive as it is attractive.

THUNDER STORMS AT SEA ARE NOCTURNAL.

THE greater frequency of thunder storms in the winter and at night around the coast of Scotland has been shown by Buchan. When thunder storms occur in New England in winter they are generally observed along the coast and after nightfall, as has been shown by records of the New England Meteorological Society. Now Meinardus, of the *Deutsche Seewarte* at Hamburg, finds even the thunder storms of the Bay of Bengal to have a distinct nocturnal maximum (Annalen der Hydrog., 1895, 506–511). It has been suggested by Grossmann and others that the cause of this contrast with thunder storms on land probably arises from the dependence of the maritime storms on instability produced by radiation and cooling of the upper surface of cloud sheets, which proceeds best at night, especially in winter nights; while local storms on the land arise from the overheating of lower layers of air close to the hot ground, and this condition has its maximum on summer afternoons.

CURRENT NOTES ON ANTHROPOLOGY.

THE ANTHROPOLOGICAL INSTITUTE OF GREAT BRITAIN.

ON January 21st this institution held its annual meeting, when its President, Mr. E. W. Brabrook, delivered the address of the occasion, reviewing the work of the body during the past year. It presents an encouraging list of papers on the leading branches of anthropologic study, and notes the advancements which have been made in the popularity of this department of learning. The establishment of a professorship of anthropology at Oxford proves that that famous University is no longer the house of refuge for effete ideas, as was once charged against it. The speaker referred to the Galley Hill skeleton (see SCIENCE, 1896, Jan. 17), and from a close personal inspection of it declares that "the balance of probability lies in favor of its authenticity." He adds some strong words on the unity of the anthropologic sciences, refuting the narrow views of Topinard, who, in direct conflict with his great teacher, Broca, would confine it to the study of physical types.

The address is one which will foster and develop the study of man in its true sense.

CANADIAN ARCHÆOLOGY.

A VALUABLE archæological report, prepared by Mr. David Boyle, appears as an Appendix to the Report of the Minister of Education, of Canada (also printed separately). It covers 79 pages, a number of which are devoted to the exposition of 'primitive industries and working methods.' Several earthworks in the province of Ontario are described, with illustrative plans and surveys. Some rock paintings are mentioned, especially one at Lake Massanog, the figures from which are reproduced, and the suggestion advanced that they indicate Huron-Iroquois influence. A number of pipes of clay and stone and arrow heads of unusual shape are figured. The timely warning is given that of late years the manufacture of fraudulent specimens of this character has notably increased, and collectors should be on the alert. To detect these 'fakes,' Mr. Boyle recommends the use of a lens of low power by which it is easy to distinguish where the partination has been destroyed.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

BATRACHIANS AND CRUSTACEANS FROM THE SUBTERRANEAN WATERS OF TEXAS.

IN advanced sheets from the Proceedings of the U. S. National Museum, Dr. Leonard Stejneger describes a new genus of batrachians from an artesian well at San Marcos, Texas, and Mr. James E. Benedict describes a new genus and three new species of crustaceans from the same well. Dr. Stejneger gives some interesting details regarding the new species of salamander-like batrachians which he calls *Typhlomolge Rathbuni*. "The animals, by their want of external eyes and their white color, at once proclaimed themselves as cave-dwellers, but their extraordinary proportions, absolutely unique in the order to which they belong, suggest unusual conditions of life, which alone can have produced such profound differences. The most startling external feature is the length and slenderness of the legs, like which there is nothing among the tailed batrachians thus far known. While the normal number of fingers and toes is present (4 and 5), it is worthy of note that not only is there a great variation in the relative length of these members, but even the length of the legs in the same animal may differ as much as two millimeters. Viewed in connection with the well-developed, finned swimming tail, it can be safely assumed that these extraordinarily slender and elongated legs are not used for locomotion, and the conviction is irresistible that in the inky darkness of the subterranean waters they serve the animal as feelers, their development being thus parallel to the excessive elongation of the antennæ of the crustaceans, of which I have been informed by Mr. Benedict. The external gills at once suggested that these animals might be only larvæ. The fact that one of them contained large eggs, and that another expelled three eggs after being caught, was no positive proof to the contrary, but in conjunction with the affinity of the species to other forms known to have persistent gills throughout life it makes it absolutely certain that we have to do with an adult and final animal."

THE FOREST RESOURCES OF THE UNITED STATES.

IN a recent circular prepared by Dr. B. E. Fernow for the Division of Forestry of the U. S. Department of Agriculture it is stated that the forest area of the United States (exclusive of Alaska) may be placed at somewhat less than 500,000,000 acres. This does not include much brush and waste land which is, and will remain for a long time, without any economic value. This area is very unevenly distributed; seven-tenths are found on the Atlantic side of the continent, only one-tenth on the Pacific coast, another tenth on the Rocky Mountains, the balance being scattered over the interior of the Western States. Both the New England States and the Southern States have still 50 per cent. of their area, more or less, under forest cover, but in the former the merchantable timber has been largely removed. The prairie States, with an area in round numbers of 400,000 square miles, contain hardly 4 per cent. of forest growth, and the 1,330,000 square miles—more than one-third of the whole country—of arid or semi-arid character in the interior contain practically no forest growth, economically speaking. The annual value of forest products is estimated at over $1,000,000,000, which makes the industry next in importance to agriculture, exceeding in the value of its products the mining industries by more than 50 per cent.

CAPE COLONY GEOLOGICAL COMMISSION.

WE have already announced the appointment, by the government of Cape Colony, of a Geological Commission, which is to report to the Secretary for Agriculture. *Natural Science* in its May number states that: "The Commission has now appointed the following gentlemen to begin the work of surveying and mapping the country: Geologist, G. S. Corstorphine, B.Sc. (Edin.), Ph.D. (Munich); Assistant Geologists, A. W. Rogers, B.A. (Cantab.), and E. H. L. Schwarz, A.R.C.S. The Commission also intends to publish in June a bibliography of South African geology, which has been compiled by Mr. Harry Saunders, the Secretary to the Commission. During the last ten years some £35,000 has been spent by the government of Cape Colony for geological purposes; but complaints have been made that, although science may have been advanced by the contribution of a scattered paper or two to English publications, or by the enrichment of the British Museum with a skeleton of *Pareiasaurus*, still the Colony itself has nothing tangible to show. For the present Commission an appropriation of £1,500 has been made for the months of December, 1895—June, 1896. It is hoped that the future work of the Commission will be carried on by annual grants of £2,000. Although South Africa abounds in mining engineers, prospectors and such-like practical geologists, of more or less competence, still not much advance in our purely scientific knowledge of its geology has been made since the days of A. G. Bain. The Commission intends to devote its energies purely to the scientific aspects of the science and to steer as clear as possible of the ordinary speculator. By this means a secure foundation will be laid for the geology of Cape Colony. The Commission will be glad to receive copies of any geological publications, in return for which they offer to forward the reports on the geology of the Colony."

THE METRIC SYSTEM.

AT the business meeting, held April 18, 1896, the Engineers' Club of Philadelphia discussed certain preambles and resolution in regard to the Metric System.

After a full debate it was decided that a letter ballot be taken on the following preambles and resolution:

WHEREAS, The adoption of an international system of weights and measures is a subject of great practical importance, and

WHEREAS, The Metric System is the most convenient general system now in use, and its continued extension indicates that it is the only existing system of weights and measures that bears a promise of universal adoption, and

WHEREAS, It is believed that the difficulties in the way of its adoption are far more than compensated by the advantages to be gained by its use, and

WHEREAS, The question of the establishment of the Metric System is now under consideration by Congress; therefore be it

Resolved, That the Engineers' Club of Philadelphia respectfully urges its Representatives at Washington to advocate the adoption of the Metric System as the only legal standard in the United States, and to promote such international coöperation as will provide unity of practice amongst commercial nations.

The result of this letter ballot has just been announced and shows 100 to 60 in favor of the preambles and resolution.

GENERAL.

THE second annual meeting of the Botanical Society of America will be held in Buffalo, N. Y., on Friday and Saturday, August 21 and 22, 1896. The Council will meet at 1:30 p. m. on Friday, and the Society will be called to order at 3 p. m. by the retiring President, Dr. William Trelease, Director of the Missouri Botanical Garden. The President-elect, Dr. Charles E. Bessey, professor of botany in the University of Nebraska, will then take the chair. The afternoon session will be devoted to business. At the evening session the retiring President will deliver a public address on 'Botanical Opportunity.' The sessions for the reading of papers will be held on Saturday at 10 a. m. and 2 p. m. The Botanical Society of America is affiliated with the American Association for the Advance-of Science, whose sessions this year begin on Monday, August 24th, in Buffalo.

THE dissolution of the New England Meteorological Society was decided upon at a meeting held April 25th in Boston. The various undertakings of the Society have either been transferred to other organizations or discontinued on account of the diversion of the interests of several of the more active members into other channels. The recent cessation of the *American Meteorological Journal* was finally the determining step in the disbanding of the Society.

Mme. Audiffred has given the French Academy of Sciences the sum of 800,000 fr., the interest of which will be awarded, without regard to nationality, for the discovery of a cure for consumption.

M. A. Renier has bequeathed 2,000,000 fr. for the establishment of a physiological laboratory in Brussels.

The *Scientific American*, which for fifty years has been an important factor in the diffusion and advancement of technical and general science, will publish an anniversary number on July 25th. It offers a prize of $250 for the best essay, not exceeding 2,500 words in length, on 'The Progress of Invention During the Past Fifty Years,' which will be published in the anniversary number.

The issue of *Nature* for May 7th will contain a photogravure of Sir Joseph Lister, President of the Royal Society, accompanied by a biographical sketch and an appreciation by Prof. Tillmanns, of Leipzig.

Messrs. Persifor Frazer, Angelo Heilprin, Benjamin Smith Lyman and Theodore D. Rand have been appointed by the Academy of Natural Sciences of Philadelphia as the Committee on the Hayden Memorial Geological Award for 1896.

A new and thoroughly revised edition of Lyell's Student's Elements of Geology is about to be published by Murray. The work has been carefully revised by Prof. J. W. Judd, Dean of the Royal College and a former pupil of Lyell's.

A special despatch to the New York *Evening Post* from New Haven states that on January 13, 1893, John E. Lewis, of Ansonia, while photographing Holmes' comet through a telescope, caught upon the plate the path of a large meteor showing its place among certain stars. Prof. H. A. Newton, of Yale, made a very careful computation showing that the meteorite probably fell at a place about two miles north of Danbury, Conn., near Kohanza reservoir. Prof. Newton has now received intelligence of the finding of a meteorite at almost exactly the computed point. It is described as an oval specimen, fifteen and a-half inches long, and seven and a-half inches in diameter, weighing twenty-six pounds.

The New York *Medical Record* states that an offer has been made by an inventor to the municipality of the city of Paris to sterilize five thousand cubic meters daily of water for public consumption at his own expense. After preliminary inquiry the municipality has decided to obtain an expert report upon the value of the proposed measure, and if it is found to be of practical utility the inventor's offer will be accepted as a preliminary to adopting the system in case the experiment is satisfactory.

Nature states that the annual general meeting of the British Ornithologists' Union was held at 3 Hanover Square on April 22d. In the absence of Lord Lilford, the President, Mr. P. L. Sclater, F.R.S., took the chair. The report of the Committee stated that *The Ibis* (the journal of the Society) had been regularly published during the preceding year, and that the Union consisted of 269 ordinary members, besides honorary and foreign members. Twenty-nine new ordinary members and one new foreign member were proposed and elected. Mr. Sclater brought forward a scheme for a new synopsis of the described species of birds, to be arranged in six volumes, corresponding with the six zoölogical regions of the earth's surface. This was referred to a committee to report upon.

Volume I., of the University Geological Survey of Kansas, by Prof. Erasmus Haworth and assistants, is now ready for distribution and may be had free by recipient paying transportation, which is twenty-two cents if sent by mail. All applications should be sent to Chancellor F. H. Snow, University of Kansas, Lawrence, Kansas.

Dr. George A. Dorsey, who has been an instructor at the Peabody Museum during the last five years, has accepted a call to the Field Columbian Museum of Chicago, to take the position of curator in the department of anthropology. Mr. Frank Russell, of the graduate school, has been appointed assistant in anthropology to take Dr. Dorsey's place as instructor in the preliminary anthropological courses next year.

THE State Fair Association of Rhode Island offers $5,000 in prizes for the exhibition and competition of horseless carriages at the State Fair, Narragansett Park, in September.

THE Committee of the Massachusetts Legislature has reported in favor of an appropriation of $100,000 to be used for the extermination of the gypsy moth. The Committee recommends that one or two entomologists be sent abroad to study the habits of the gypsy moth with a view to introducing, if possible, some parasite to prey upon the insect.

ANDREW S. FULLER, a writer on agricultural and botanical subjects, died on May 4th, at his home at Ridgewood, N. J., age 88 years. The death is also announced of Alfred Debains, professor at the agricultural college at Rennes.

PROF. ANGELO HEILPRIN has been appointed to represent the Academy of Natural Sciences of Philadelphia at the Mining and Geological Millennial Congress to be held at Budapest, September 25th and 26th, in connection with the celebration of the founding of the Kingdom of Hungary.

MR. GILBERT BOWICK has purchased for the British Antarctic Expedition, which leaves England in September, the survivors of the pack of dogs acquired by Lieut. Peary from the Esquimaux of North Greenland. They will be brought from Christiania and placed for the present in the London Zoölogical Garden.

AT a meeting of the Royal Geographical Society on April 27th the President announced that the annual honors had been awarded by the Council as follows: The Founders' Medal to Sir William Macgregor, K.C.M.G., for the valuable geographical work he has done in New Guinea during the years that he has acted as Administrator and Lieutenant-Governor; the Patrons' Medal to Mr. St. George R. Littledale for his important expeditions in the Pamirs and Central Asia; the Murchison award has been given to Khan Bahadur Yusuf Sharif, native Indian surveyor; the Gill memorial to Mr. A. P. Low, of the Canadian Survey, for his explorations in Labrador; the Black grant to Mr. J. Burr Tyrrell for his expeditions to the Barren Grounds of northwest Canada; and the Cuthbert Peek grant to Mr. Alfred Sharpe for his many journeys in British Central Africa. The following geographers have been made honorary corresponding members of the Society: M. de Semenoff, Vice-President of the Russian Geographical Society; Dr. Von den Steinen, President of the Berlin Geographical Society; Dr. G. Neumayer, Director of the Naval Observatory, Hamburg; M. de Lapparent, President of Council of the Paris Geographical Society; Dr. Albrecht Penck, Professor of Geography, Vienna University; Dr. Otto Petterson, the Swedish oceanographer; Dr. Kan, President of the Dutch Geographical Society; Prof. H. Pittier, Director of the National Physico-Geographical Institute of Costa Rica.

STILL another welcome contribution to our knowledge of the changes of plumage in birds is a paper by Witmer Stone entitled *The Molting of Birds with Special Reference to the Plumages of the Smaller Land Birds of Eastern North America.* This appears as a separate from the Proceedings of the Natural Sciences of Philadelphia and discusses in more or less detail the molt of some 130 species. A captious critic might, perhaps, complain that in some cases the conclusions were based on an examination of rather a small number of specimens, but only one who has undertaken similar investigations can appreciate the difficulty of obtaining proper material and the labor involved in its study. There is an introductory chapter treating of molt in general, in which Mr. Stone briefly discusses the question of direct change in the color of feathers and states that he cannot admit that we have any proof of an actual change of color in a feather apart from what may be produced from abrasion or bleaching. The author, by independent investigation, reaches the same conclusion as Mr. Chapman in regard to the change of color in the Dunlin and Snowflake. There has been abundant *testimony* to change of color in feathers without molt, and it is now in order for some one to produce a little evidence.

Two interesting additions to the alums have been recently made by Piccini and are described in the *Gazetta Chimica*. By the reduction of a sulfuric acid solution of vanadium dioxid in the electrolytic cell in the presence of an alkali-sulfate an alum is formed. The ammonium vanadium alum is very soluble, those of rubidium and cesium much less so. By a similar reaction Piccini has obtained the cesium titanium alum, the first of the titanium sulfates to be formed. These salts are the first representatives of the alums among the elements of the fourth and fifth groups of the periodic system.

THE question as to the fusibility of platinum in a carbon heated furnace seems at least to have been definitely settled by Victor Meyer. A sheet of platinum completely enclosed in a mass of fire clay was fused to a globule in a blast furnace heated with gas carbon. In this case action of carbon or of furnace gases on the platinum was absolutely excluded. Under similar conditions an alloy of platinum with 25% iridium was unchanged.

IN the *Contemporary Review* for May, Dr. Alfred B. Wallace describes M. Elisée Reclus' proposed gigantic model of the earth, already noticed in this JOURNAL and argues that the construction of such a globe would be feasibile and desirable. But he thinks that the scale proposed by M. Reclus, $\frac{1}{100000}$ should be reduced by one-half. This would give an internal diameter of 167 feet, and a scale of almost exactly a quarter of an inch to a mile. The chief point made by Dr. Wallace is, however, that the model should be placed on the inner surface of the sphere.

ACCORDING to *Nature*, on July 2d the Second International Congress of Applied Chemistry will open in Paris. In addition to strictly technical questions, the Congress will discuss the analytical processes needed for the guidance of manufacturers and the benefit of the consumer. The proceedings will be conducted in ten sections, and, judging from the number and interest of the questions which will be brought up in each, there will be no lack of work. The sections represent such diverse subjects as chemical products, electro-chemistry, coloring matters and dyeing, pharmaceutical products, metallurgy and mining, surgar-refining, vintnery, brewing, distilling, agricultural chemistry, photography, alimentation and milk supply. The 'Association des Chemistes de Sucerie et de Distillerie,' which is organizing the Congress, has formed a committee, comprising several members of the French Government, a large number of members of the Institute, and many of the foremost men in science and industry in France. Further information with reference to the Congress can be obtained from M. Dupont, 156 boulevard Magenta, Paris.

UNIVERSITY AND EDUCATIONAL NEWS.

MRS. STANFORD has transferred to the trustees of Stanford University $2,500,000, the amount of the bequest left by the late Senator Stanford.

MR. JOHN D. ROCKEFELLER has agreed to give Vassar College $100,000 toward the erection of a new dormitory or a recitation hall.

AT a meeting of the trustees of Columbia University, on May 4th, Mr. E. A. MacDowell was appointed Professor of Music, and Dr. Franz Boas lecturer on physical anthropology. The name of the present faculty of the School of Mines was changed to that of the Faculty of Applied Science, which will be intrusted with the care of the School of Mines, the School of Chemistry, the School of Engineering and the School of Architecture. The building for the Department of Chemistry, to be erected as a memorial to the late Frederick Christian Havemeyer at a cost of about $450,000, by his sons and daughters, F. C., Theodore A., Thomas J., and Henry O. Havemeyer, Mrs. Katherine B. Belloni and Mrs. L. J. Louisa Jackson, and by his nephew, Charles H. Senff, was formally accepted by the trustees.

THE sum of $100,000 has been given by friends of Barnard College to pay the mortgage on the grounds, and secure the gift of $100,000 for building purposes pledged on condition that the mortgage should be paid by May 9th.

THE summer school of Union College will hold a session of six weeks at Saratoga, from July 6th to August 14th. Thirty courses are offered. The ninth annual session of the Wisconsin summer school will be held at the University for six weeks, from July 6th to August 14th,

1896. Thirty-seven courses of instruction will be offered in fourteen departments.

THE announcement is issued of the Fifth Annual Summer School at the University of Minnesota for the four weeks between July 27th and August 21st. The school is organized in two sections: University and Elementary. The University section offers 19 courses, of which 10 are in the Sciences, as follows :

Botany, Prof. MacMillan, ...2 Courses.
Chemistry, Prof. Frankforter,...........2 Courses.
Physics, Prof. Jones,........................2 Courses.
Physiography, Mr. Goode,.................2 Courses.
Physiology, Prof. Nachtrieb,.............1 Course.
Physiological Psychology, Mr. Gale,...1 Course.

Special courses of lectures will be delivered daily. Four Educational Congresses will hold sessions during the month, viz.: Institute instructors ; State Normal School officers ; City Superintendents, and the Society for Child Study. The School is authorized under the anthority and supervision of the State Department of Public Instruction. Tuition is free.

PROF. HAROLD B. SMITH, at present professor of electrical engineering in the Purdue University, Lafayette, Ind., has been elected to a new chair of electrical engineering, established in the Worcester Polytechnic Institute.

AMERICAN students going abroad for the summer may be interested to know that there will be held at Jena, from the 3d to the 15th of August, a *Ferienkurse*, including lectures on astronomy, botany, physics, zoölogy, hygiene, physiology, psychology, philosophy, pedagogy, modern languages, literature and history.

A COURSE of lectures on colonial botany is offered during the present summer semester at the Botanical Garden and Museum of Berlin, by Profs. Engler, Schumann, Volkens and Urban, and Drs. Warburg, Gilg, Lindau, Perring, Dammer and Gürke. The course occupies two hours per week and is given without charge.

WE learn from the *Academische Rundschau* that a regulation has been issued allowing women to attend lectures at the University of Berlin after securing permission from the Minister of Public Instruction and the instructor. The University of Munich has given one woman permission 'experimentally' to attend courses in geology and paleontology. Special courses for women, which include botany, physics and chemistry, have been arranged at the University of Göttingen.

THE sum of 460,000 Marks has been appropriated by the government for the construction of a library building for the University of Freiburg.

DISCUSSION AND CORRESPONDENCE.

PRINCIPLES OF MARINE ZOÖGEOGRAPHY.

PROF. THEO. GILL* has given a very interesting comparison of his own views of zoögeographical division of the earth's surface, especially of the oceans, and those set forth by myself in my 'Grundzüge der Marinen Tiergeographie.' This comparison is the more interesting since we agree in many points with each other. Nevertheless, there are some differences which, as Prof. Gill very properly states, are chiefly due to the different starting points. The discussion is consequently directed at once in a particular direction, and upon this I wish to lay the greatest stress: namely, upon the difference between my method of investigation and that generally employed hitherto. While the method of Prof. Gill, and of almost all the other students of zoögeography, is an inductive one, *i. e.*, constructing zoögeographical divisions according to the actual distribution of animals, I make use of the deductive method, considering merely the physical laws that govern the distribution of animals. In what follows I shall state briefly the reasons which have induced me to urge a change in the method of zoögeographical research.

1. Our knowledge of the actual distribution of marine animals is extremely incomplete ; we do not know the exact limits of the range of *most* of the species, so that it is impossible at present to get a correct idea of the general features of their distribution, and of the assemblage of the different forms of animals in any particular locality.

2. We cannot derive any divisional limitations of general value from a particular group

*Science N. S. III., No. 66, April 3, 1896, p. 514–516.

of animals, since each group is subject to different laws. Thus a division obtained by the study of the prevailing conditions in one group is often exactly the opposite of that found to prevail in other groups. From this disagreement arose the continuous dispute between different writers with regard to the number and the limits of the zoögeographical divisions, each wishing to transfer the results obtained in his favorite group to other groups.

3. The actual distribution of animals is the result of development during the course of the geological history of the earth. While many animals show a distribution which corresponds to the physical conditions of recent times, many others point clearly to conditions of former periods, and their distribution is only intelligible under the supposition that formerly different conditions prevailed on the earth.

Thus we should expect that investigations founded on the actual distribution of animals are in the first place incomplete, and in the second the results obtained are contradictory in many cases. In order to overcome the latter difficulty, statistical lists of the distribution of these animals have been prepared showing which distributional features are most common. But I object even to these statistics. My first reason shows clearly that such statistics never are complete, and it is very dangerous in science to rely upon statistics deficient in the main quality by means of which they are useful at all.

From these considerations I am induced to use the deductive method, and to construct zoögeographical divisions according to the differences in the physical conditions influencing the distribution of animals. But I remark expressly, I do not regard such a division of the earth as the final aim that should be reached in zoögeography, but only as a means which facilitates zoögeographical study. My divisions represent only *a rough sketch of the distribution of the different conditions of life in recent time.* Of course, these divisions do not agree with those assigned to animals the range of which is due to conditions belonging to former times; but even in such cases my divisions have a decided advantage. If there are any exceptions in the actual distribution of certain forms we see at once that these animals do not follow the general rules according to which the divisions are conceived, and the knowledge that certain laws do *not* control particular cases is a considerable advantage in revealing the true causes of these peculiarities. For the whole point or aim of zoögeographical research is to find out the *causes of the distribution* of each animal form.

The above reasons, I think, are sufficient to demonstrate that my starting point has certain advantages over that of other students in zoögeography. Notwithstanding the results of my investigations are very similar to these obtained by Prof. Gill. This is due, I believe, to the extensive and correct character of his preliminary work, to the exact and fundamental study of the actual distribution of certain groups of animals, and to the full use he has made of the known facts. On the other hand, I think, Prof. Gill's method is not so fundamentally different from mine as it seems to be perhaps according to his own statement. It is true he 'prefers the inductive method' (p. 515), and his divisions are adapted in some degree to the actual distribution of certain animals; nevertheless his chief marine divisions are conceived according to a *physical* principle, to the *temperature* of the ocean waters, a principle which was first introduced by Dana, and the importance of which is recognized by Prof. Gill in the concise sentence: "Temperature is a prime factor, and land a secondary, in the distribution of marine animals."* On this point our opinions agree completely, and thus, I think, our starting points are not so extremely different, since Prof. Gill in constructing his zoögeographical divisions of the seas pays due attention to temperature, which is at least one, and indeed the most important, physical factor.

With regard to the objections of Prof. Gill to my life districts, I should like to add here that I do not fully understand why he says they are misconceived, since they are framed in contravention of my own principle of continuity. If all the life districts were continuous, any further divisions would be impossible and needless, as is the case in the abyssal (bassalian) district, and even the discontinuity of the others obliges

*Presidential Address Biol. Soc. Washington, Jan. 19, 1883, p. 39.

us to make further divisions so as finally to reach continuous and consistent areal units. I formed my division into life districts according to the primary conditions of life, and I never claimed that all the localities on the earth showing the same primary conditions of life should be continuous; I only claimed that the smallest areal units of zoögeographical division should be continuous. Different conditions of life have existed since the beginning of the geological history of the earth; the secondary divisions into regions of the marine life districts, which were formerly continuous in a greater or less degree, are made according to the topographical continuity, which was interrupted by the introduction of climatic differences in much later times. The assigned districts of life are old, and during a long time they were the only zoögeographical divisions of the seas. The different regions of the life districts are of a comparatively recent date, and their existence did not begin until a differentiation of climate took place.

Prof. Gill further suggests that the life districts themselves are of unequal value, and they should be seggregated into two primary categories, marine and inland. I agree perfectly with this view, as the same view is maintained in my book, the title of which reads: 'Principles of *marine* zoögeography,' thus leaving out of view the consideration of *inland* districts. Further, I expressly state (p. 18–20) that the diagnostic value of my five life districts differs, for if we were to establish a perfectly philosophical division we should have to introduce other districts, but only the five named are of *practical* value. The fact that the marine life districts are unequal as regards the number of subdivisions I cannot consider as an objection to their correctness. Indeed, in this respect they *are* unequal, but if they are unequal in nature why should we try to correct nature in proposing a scheme on paper in which the divisions would appear more equal than they really are?

I am glad that Prof. Gill by his remarks has given me an occasion to state again in a concise form my reasons for neglecting the inductive or statistical method in zoögeography. I think that practical results favor my method, especially since there is a remarkable parallelism in both divisions, Prof. Gill's and mine. This fact suggests that an agreement of both is at least possible, and then, perhaps, some of the scientific terms of Prof. Gill would have the priority and should be used, as most of the terms used by me are certainly in that particular sense of more recent date.

ARNOLD E. ORTMANN.

PRINCETON COLLEGE, May, 1896.

'THE CHILD AND CHILDHOOD IN FOLK-THOUGHT.'

TO THE EDITOR OF SCIENCE: In the issue of March 27th Dr. Brinton has dwelled on the literary merits of Dr. A. F. Chamberlain's book 'The Child and Childhood in Folk-Thought.' As, aside from its literary aspirations, the book is intended as a contribution to Anthropological Science, I may be permitted to add a few words from this point of view.

Dr. Brinton has well said that the book represents a vast amount of compilatory work. The author deserves our thanks for having delved in numerous odd books in which we should hardly expect to find information on the subject of childhood, and for having extricated a considerable number of references from ethnological literature. He has thus largely increased the available material on studies of childhood. These references he has conveniently arranged in a bibliographical index.

While this preparatory work is very meritorious, particularly in so far as it refers to uncommon books, the attempt at a scientific arrangement of the material thus obtained does not appear successful. If scientific description was the author's aim it was incumbent upon him to arrange his material from certain points of view in a systematic way. If he desired by inductive methods to investigate certain phenomena it was his duty to array his facts for the purpose of finding the elements common to all of them. His book fills neither the one nor the other requirement.

A characteristic instance of lack of organic connection is the seventh chapter, 'Affection for Children.' The subject-matter treated is as follows: Parental love, the dead child, motherhood and infanticide, the dead mother, fatherly affection, kissing, tears, cradles, father and child.

The sixth chapter, 'Primitive Child-Study' or 'The Child in the Primitive Laboratory,' embraces the following headings: Licking into shape, massage, face games, primitive weighing, primitive measurements, measurements of limbs and body, tests of efficiency, sleep, heroic treatment.

I believe these two statements show that the points of view, according to which the author has coördinated his material, are based entirely on considerations foreign to it. This is particularly clear in the sixth chapter. The various customs collated there have hardly any psychological connection and can, therefore, not be held to elucidate in any way the mode of thought of primitive man. He neither thinks of studying children—as we are just beginning to do—nor does he subject them to tests. The customs recorded by the author are practiced for a variety of purposes, but, certainly, the fact that they resemble in a general way tests which we might apply does not give us a right to consider them as psychically connected.

Almost the only chapters in which we can find a connecting idea are the philological ones with which the book opens. In these the author makes a compilation of the uses to which the terms 'father' and 'mother' have been put by various people. But here another lack of the whole work becomes particularly glaring. The quotations are gleaned without any attempt at criticism, and much of the material that is offered is not a safe guide to follow, because the observations and investigations of the writers referred to were not sufficiently thorough.

The book is an illustration of the dangers with which the comparative method of anthropological investigation that has come into vogue during the last quarter of a century is beset.

The fundamental idea of this method, as outlined by Tylor and in the early writings of Bastian, is the basis of modern anthropology, and every anthropologist must acknowledge its soundness.

But with its growth have sprung up many collectors who believe that the mere accumulation of more or less similar phenomena will advance science. In every other science the material on which induction is based is scanned and scrutinized in the most painstaking manner before it is admitted as evidence. It is absurd to believe that anthropology is entitled to disregard this rule, which is acknowledged as fundamental in all other inductive sciences. Furthermore, the object of anthropological research being to elucidate psychological laws on the one hand and to investigate the history of human culture on the other, we must consider it a primary requirement that only such phenomena are compared as are derived psychologically or historically from common causes. How this can be done has been shown by no one better than by Tylor. Only the common mistake of attributing any two phenomena that are somewhat alike to a common cause can explain the reasoning that led the author to amass and to place side by side entirely heterogeneous material.

I believe anthropologists, by silently accepting as a contribution to science a compilation like the present made on unscientific principles, will give countenance to the argument that has been brought so often against anthropology as a branch of science: namely, that it is lacking in a well defined scientific method and that, therefore, it is not equal in rank to other sciences.

FRANZ BOAS.

NEW YORK, May 1st, 1896.

THE DISCUSSION OF INSTINCT.

TO THE EDITOR OF SCIENCE: I have been much interested in the letters in your columns on the instinctive activities of young birds. Certain opinions which I hold—and others that the writers suppose that I hold—have been criticised. To explain my exact position, however, would occupy more space than I can reasonably ask you to afford me. May I be allowed, therefore, to content myself with stating that I have in preparation a work on *Habit and Instinct* which will, I hope, be published towards the close of this year. There my own observations will be described and reference will be made to the work of other observers, and there the provisional conclusions drawn from such observations will be discussed. I desire to make this statement, lest my silence should be regarded as discourteous in the country where I met with so much kindness and such uniform courtesy.

C. LLOYD MORGAN.

UNIVERSITY COLLEGE, BRISTOL, ENGLAND.

THE SUBJECT OF CONSCIOUSNESS.

EDITOR SCIENCE: Referring to the review of my 'Lehrbuch der Allgemeinen Psychologie' in your valuable magazine for September, 1895, which has but recently come to my notice, I sincerely regret that the reviewer should have fallen into so manifest an error as to suppose the 'subject of consciousness' of my 'Psychologie' to be equivalent to 'self-consciousness;' though he expresses himself with some hesitancy when he says 'it seems most nearly,' etc. As I have pointed out in my work, the misunderstanding is quite apt to arise, from the fact that the word 'subject' is often used in the sense of the 'Ego' or 'Self,' as even shown by the reviewer when he says, 'the consciousness of self *or* subject.' But that is just the very sense in which I do *not* use the word 'subject.' With me, the 'subject of consciousness' does not designate the 'Ego' or the 'conscious mental individual,' but only its fundamental unifying general abstract element, which always exists in the closest union with the other element, which I call *attribute* of consciousness, and *with which* it constitutes the individual unit 'consciousness' or 'conscious individual.' When this is distinctly understood it will be impossible to mistake the 'subject of consciousness,' *i. e.*, the psychological foundation of *all* mentality, for 'self-consciousness,' which is but a later development of the *individual* mind, the 'mental *individual*.' It is a source of great satisfaction to me to have been the first to call attention to this fundamental unifying element. I call it 'subject,' though I shall gladly give up the name if any one will suggest another that is not so liable to be misunderstood. In my 'Psychologie' I lay particular stress upon the fact that, if this 'subject' were not originally present in mental life as the unifying element, together with the attributes of consciousness (sensations, feelings, etc.); if, therefore, as the associationists think, mental life were possible without a subject of consciousness, it would be impossible to explain 'self-consciousness,' which makes its appearance later; for it is precisely this self-consciousness, which is based primarily upon the existence of the 'subject' as an element of consciousness; but *for that very reason* it is far from being identical with that 'subject.'

JOHANNES REHMKE.

GREIFSWALD, April 16, 1896.

THE PREROGATIVES OF A STATE GEOLOGIST.

EDITOR SCIENCE: In connection with the communication of Dr. Keyes, published in SCIENCE, April 24th, page 365, permit me to say to any who may have a passing interest in the subject that I sent the impression paper copy of the original manuscript to the Editor of SCIENCE with a copy of the publication as it appeared, with a request that he kept the two for some months in order that any one wishing to look into the matter might have an opportunity to do so and judge for himself whether I wrongfully represented matters in my communication published in SCIENCE of April 3d last. I might also state that I sent Dr. Keyes a copy of the letter nearly three months before it was published, with a statement that I would publish the same if he did not do something to give me credit for that which was mine, but which had been published under his name.

ERASMUS HAWORTH.

A CORRECTION.

IT is unfortunate that although the figure from Dr. Mügge's paper which I reproduced in SCIENCE last week (p. 698) was expressly marked 'top' on one side, it has been inserted upside down by the compositor. In its present position the figure is meaningless and even misleading.

T. A. JAGGAR, JR.

THE ABSOLUTE AND THE RELATIVE.

TO THE EDITOR OF SCIENCE: Your correspondent 'M.,' in the number of SCIENCE for April 24th, raises a new issue with me; one which has only an indirect bearing upon the subject matter of my article on the 'Illusion Concerning Rest.' In that article I attempted to demonstrate that motion cannot be created or destroyed by collision, but that the body in motion can be only deflected thereby. Now my friend abandons that demonstration and raises another question about the nature of the absolute and the relative in motion, and shows that he entertains an illusion concerning relation. Of this illusion I shall treat hereafter in another article.

If there was but one particle in the world having motion it would change place. Such a particle does not exist alone, for there is a multeity of particles; but one particle can be considered as existing alone. The particle then would change its place because it had motion, and one place can be compared with another; but as in fact there are a multeity of particles there is also position which is a relation among particles and we may therefore define motion as change of position, and as other particles have motion it is a mutual change of position. By comparing the one particle with the many the demonstration of its motion is perfected. By comparing the motion of a molar body with the motion of its particles and also with the motion of the earth it is seen that molar motion may cease, but that this cessation does not end its molecular nor its stellar motions. That a molar body may come to rest only one of its modes of motion must be destroyed, therefore, rest is not the end of all the motion of any molar body but only the stoppage of molar motion. I have pointed out that the creation of molar motion is the deflection of the other motions inhering in the body and also that the destruction of molar motion is also the deflection of other motions in the body, and no scientific man will deny these propositions; but scientific men have believed that the creation and destruction of molar motion involves not only deflection, but also under some circumstances, though not under all, creates and destroys motion as speed. This I deny and challenge any scientific man to demonstrate any creation or destruction of motion; and, more than that, I claim that Newton's law of motion and the doctrine of the persistence of energy both teach that motion cannot be created or destroyed.

To define motion as change of position instead of change of place is advantageous, for scientific men desire to measure motion both as speed and as path; but to measure a quantity and express it, it must be measured in terms of another and expressed in terms of another. Thus it is that science uses the best definitions for its purposes. I would not write for a scientific journal if I did not believe that I was making a contribution to science. In the case of this series of articles I confidently believe that I shall make a contribution to psychology. I desire to explain the nature of certitudes and illusions by explaining specific certitudes and illusions, and finally I wish to explain the law of mental evolution which is the eliminating of incongruous notions and the criterion for distinguishing certitudes from illusions. Now, my friend need not fear that the bottom will drop out of any real science.

The illusion concerning relation is a fundamental notion in idealism. Those who have fully thought out idealism in all its consequences, as Kant seems to have done and Fichte and Hegel surely did, first attempt to resolve all material phenomena into relations, then affirm that the only absolute is found in mind and that all actuality is mind and that the material universe exists only in thought. I shall attempt to show the certitudes and illusions contained in this philosophy, and for this purpose it becomes necessary for me to define, illustrate and demonstrate the absolute, then to define, illustrate and demonstrate the relative, and finally to point out the illusions concerning the absolute and the relative which have existed and which are especially characteristic of metaphysic, but which sometimes exist in science.

That which exists in one and is essential to its existence is absolute, but as there is more than one, that absolute necessarily becomes relative because there is more than one. In the world there is no such thing as a pure absolute and there is no such thing as a pure relative. If there is no absolute there is no world; if there is no relative there is no world. This is one of the fundamental propositions which I am seeking to demonstrate, and for that purpose I am seeking to point out both elements, that the phantasy of metaphysic may be dispelled, and science may not be burdened with illusions. In my article on rest I tried to point out one of these illusions which inheres in all metaphysical reasoning and which lingers in scientific reasoning in spite of the Newtonian definition of motion and the definitions given to momentum, energy, force and power. Curiously, I find that even some physicists have not mastered these definitions and still entertain the historical illusion concerning the nature of rest. If my demonstration is studied it will be accepted only in case it does not conflict with some other notion, as that about the nature of relation.

Finally, let me present three other propositions: First, to produce rest in one body it is necessary to transmute one mode of motion into another; second, to produce a new mode of motion it is necessary to transmute a part or the whole of some other mode of motion. Both of these definitions are included in the axiom which I have previously given, that motion cannot be created or destroyed. Third, if motion is not both absolute and relative it does not exist.

J. W. POWELL.

SCIENTIFIC LITERATURE.

Life, Letters and Works of Louis Agassiz. By JULES MARCOU. With Illustrations. Two volumes. New York, Macmillan & Co. 1896. Pp. 302, 318.

Mrs. Agassiz's life of her illustrious husband has always been considered a model of what such a biography should be, full and minute where the matters were important, brief where they were trivial, and composed by elimination rather than agglomeration, so that the effect is massive and interesting from first to last. Mr. Marcou seems to have aimed at muchness of matter rather than excellence of form, and the result is a very different sort of book, realistic and abounding in *traits vifs*, but pervaded by a curious commonness of tone, and by a lack of style rather odd in a Frenchman. In his eagerness to supply every detail of date, place, persons present etc., where events are recounted, too many pages are filled with mere statistical enumeration.

Too much is said of individuals who play subordinate parts in the narrative, and who ought either to have been subordinated still more or made more interesting by becoming more prominent. Any attempt on the part of an outsider to give an in-door view, a view *en robe de chambre*, so to speak, of a man whose family is still living, savors of a certain bad taste, and the strained air of familiarity on Mr. Marcou's part ends by displeasing the reader the more, as it frequently appears to be an appearance of knowingness rather than a real knowledge, where minor events and personages are considered.

It offends most in the author's handling of certain persons who, having once been co-workers with Agassiz, had in one way or another ceased to be his friends. Human nature, even when in the wrong, demands something more than this off-hand contemptuous treatment, or else something less in the way of space taken up. The book, moreover, is written most disjointedly, is full of repetitions, and its comments on Agassiz's zoölogical philosophy are sadly beneath the level of the subject. But in spite of these defects—and they are truly grave ones—Mr. Marcou has evidently taken great pains with his volumes, and has achieved a result which probably comes quite near that at which he aims. In spite of his non-idealizing temperament, he genuinely admires his hero; and what with his facts, his broader appreciations, and all his little dabs and touches, the reader gets at last a picture of Agassiz which is both vivid and realistic, and awakens sympathetic admiration far more than any other kind of comment. Agassiz's personality was indeed so immense, his passions so overpowering, his enthusiasms so magnificent, his sociability and friendliness so great, that no other result was possible. His life, in all its phases, becomes inevitably a sort of heroic romance. Never was there so glorious a youth. At 20 he was a great collecting naturalist. At 22, whilst a student at Munich, he had published his folio describing Spix's collection of Brazilian fishes. At 23 he had begun work on his *Histoire Naturelle des Poissons.* At 26 his *Recherches sur les Poissons fossiles* began to appear. At 30 he had proved the 'Glacial Epoch' and received the Wollaston medal from the Geological Society—a unique honor for so young a man. Mr. Marcou catalogues 43 publications from his pen, many of them of the first order of magnitude, before his 31st year. And all this with no basis of support but his absolute devotion to natural history and faith in his own powers. At Munich, with his naturalist student friends, "almost everything was enjoyed in common; work, pleasure, journeys, pipes, beer, purses, clothes, ideas, political and philosophical, or poetical, and even literary. In fact, it was a constant, enthusiastic, intellectual life, lived at high pressure, lacking in nothing; not even student-duels, and escapades of a more riotous nature after grand 'Kommers.' Agassiz enjoyed, among the students, the reputation of being the best fencer in the various students' clubs * * *. Strange to say, with an allowance of only $250 a year, [he] managed constantly to keep in his pay an artist, Dinkel, to draw fossil and living fishes, and occasionally a second artist, Weber, to draw the Spix fishes and pieces of anatomy. They formed a sort of fraternal association. As Agassiz said, 'They were even poorer than I, and so we managed to get along together.' Their fare was certainly very simple, bread, cheese, beer and tobacco being the main articles. Imagine Agassiz, with his scanty allowance, providing for two artists, besides Carl Schimper and his younger brother, William Schimper. To be sure, Alexander Braun helped much also. But if we suppose that Braun got $300 a year from his father, six young men, between the ages of twenty and twenty-five, had to live upon less than $600 a year, out of which, also, they had to pay for their studies at the University and provide themselves with instruments and books and clothing. Agassiz got a little money from the 'Brazilian fishes' and some other writing, with which he purchased a microscope—a rather expensive instrument—and several books; and he received, as a gift, from Prof. Döllinger, a copy of the finely illustrated work on living fishes by the great French ichthyologist, Rondelet, of Montpelier. The editor Cotta sent him also a considerable number of expensive natural history books. * * * His room was used as lecture-room, assembly-hall, laboratory and museum. Some one was always coming or going. The half-dozen chairs were covered with books, piled one upon another, hardly one being left for use, and visitors were frequently obliged to remove books and put them on the floor; the bed also was used as a seat, and as a receptacle for specimens, drawings and papers. According to Agassiz, the tobacco smoke was sometimes so thick that it might have been cut with a knife. Agassiz was the most prominent among the students. His acquaintance was courted by all. * * * He was considered a most amiable companion, never losing his temper, always smiling and apparently contented and happy. * * * * There is no other example of such a rapid rise to great scientific reputation as Agassiz enjoyed in his thirtieth year. * * * His power of classifying fossils and his success in reducing to order thousands of specimens of fishes, a great many of which were perfect puzzles to everyone, were simply marvellous; and he worked at his herculean task as no man but a man of genius could have done." (Vol. I., pp. 25, 113.)

Probably no one again will ever have as vast an acquaintance with living things as Agassiz possessed. No man will love Nature's forms more passionately. But biological science now expects more help from what the pedagogues call 'intensive' than from 'extensive' study, and her progress will for the present probably consist more in the unravelling of causes and conditions than in the description of new surface facts. Agassiz is the last of the type of great naturalists who took the individual forms of Nature at their simple surface value as living wholes. Causal laws have their nobility of outlook too, but it is of more abstract and sadder sort. 'Die Form ist zerbrochen, von Aussen herein,' we may say with the poet, when we come to deal with recent speculative biology; and those thoughts of God that Agassiz conceived himself to read off so easily were no doubt in form at least more like the real thoughts of God, in being intuitions of fully concrete facts, than are those poor naked forces and processes and logical elements of things with which our later science deals. Some day our descendants may get round to that higher way of looking at Nature again. Meanwhile from this book, as from every possible book about Agassiz, there floats up a breath as of the morning of life, that makes defects of taste and small in accuracies seem of little account. We recommend it therefore to our readers cordially enough.

Fear. ANGELO MOSSO. Translated from the fifth edition of the Italian by E. Lough and F. Kiesow. London, New York and Bombay, Longmans, Green & Co. 1896. Pp. 278.

Prof. Mosso is one of the most eminent of modern physiologists, and he is an Italian. This book bears ample witness to both facts. It is largely occupied with descriptions of the author's ingenious experiments on the cerebral blood-supply, and is written with naïve openness, eloquence and assurance that read more oddly in the English translation than in the original Italian.

The book not only describes the emotions, but also expresses them and appeals to them. It contains graphic descriptions of convivial feasts and death-bed scenes, even of a syphilitic woman and of a head cut off from the body. We are told of the author's feelings at his mother's grave and on which side of the face his sister blushes. The book is expressly intended for the general public, but will probably, in the Anglo-Saxon race at least, contribute less to its instruction than to the morbid appetite already sufficiently fed by the daily newspapers.

The first half of the book discusses chiefly the functions of the brain and spinal cord, and more especially the relation of the circulation of the blood to emotional disturbances. It is well known that we owe to Prof. Mosso the method of measuring the decrease in the volume of the extremities of the body due to congestion of the brain when it is excited by mental activity, the balance showing the movement of blood to the brain, and many other important investigations on cerebral circulation. Mosso's work in this field is of much value and originality, and it is an advantage to have it accessible in English, even though the method of presentation is not very systematic nor scientific.

The second half of the book is concerned chiefly with the expression of the emotions, not being confined exclusively to fear. Mosso argues against the view that the expression of the emotions must of necessity be useful to the individual. As the translation makes him say 'Spencer and Darwin were not physiologists enough.' It is undoubtedly true that certain expressions of the emotions are pathological. Trembling, as an effect of fright, is probably no more useful to the individual than *paralysis agitans*. There are evident limits to the adaptability of the organism. The nervous system best suited to respond to ordinary stimuli may and does fail in the presence of unusual conditions. Mosso does not accept Mantegazza's extraordinary theory that a frightened animal trembles to keep its blood warm, but he holds that this is the reason why its hair stands on end!

The psychology in the book is not such as to warrant serious criticism. Mosso writes:

"We imagine that the impressions of the external world form a current which penetrates the nerves, and without either abatement or check, diffuses and transforms itself in the centers, finally reappearing in the sublime form of the idea; this is the notion of the soul held by the philosophers of remote antiquity; this is the base of modern psychology."

Indeed, the book does not appear quite contemporary; there is no discussion of the relation between pain and sensation, nor of the James-Lange theory of emotions, according to which the expression is the cause of the emotion and not conversely. The heredity of acquired characters is taken as a matter of course. We are told "civilization has remodeled our nerve-centers; there is a culture which heredity transmits to the brains of our children."

The reader who looks for an index will find in its place a twenty-four page catalogue of Messrs. Longmans, Green & Co.'s publications.

J. MCKEEN CATTELL.

Naturwissenschaftliche Einführung in die Bakteriologie: By FERDINAND HUEPPE, University of Prague. 268 pp. C. W. Kheidel, Wiesbaden, Pub.

Books upon bacteriological technique have been somewhat common in recent years but nothing has hitherto appeared, which, leaving out laboratory methods and systematic details, gives a summary of the important discoveries of modern bacteriology. The reputation of the author of the present work as one of the leaders in modern bacteriology is a sufficient guarantee of its value from a scientific standpoint, and the subjects treated are a sufficient guarantee of its interest. To one who wishes to know what bacteriology has accomplished and what problems are still undergoing solution nothing can serve better than this outline of Prof. Hueppe.

Beginning with a brief yet complete treatment of the morphology of bacteria and their relations to other groups of plants, the author passes to a consideration of their relations to their environment. Valuable sections are given upon the effects of light, temperature, oxygen, poisons, etc. He treats of the effect which bacteria have upon the medium in which they are growing, of the products to which they give rise, as well those produced by the decomposition of the culture medium as those produced by synthesis and as secretions. He deals of the subject of the food necessary for the life of the various organisms, and in this section, in short, gives a general survey of the relations of bacteria to the environment, thus indicating how and why they may play an important part in nature's processes.

A summary of the relations of bacteria to diseases follows. The different types of germ diseases are distinguished and their relations to micro-organisms. The discussion is more than a simple collection of facts. It brings into prominence the distinction between strictly pathogenic bacteria and those which are pathogenic only under special conditions, between those which are always injurious and thus strictly parasites, and those which are normal harmless occupants of the human body, but which occasionally produce trouble. It emphasizes the personal factor in the matter of infection or in preventing the invading organisms from developing. The discussion can hardly fail to clear our notions, since it gives a sharp and happy summary of our present knowledge of the relation of various diseases to parasites and of the individual to the infecting bacteria.

The most novel and original part of the book is the somewhat extended discussion of the causes of disease and the methods which bacteriology is promising as a means of meeting the various diseases. This subject is too comprehensive and too condensed for summary. The author finds the potent cause of disease rather in the organism itself, looking upon the pathogenic organism simply as a stimulus. He succeeds well in disentangling the miscellaneous confusing facts which have accumulated in the last few years upon the matter of toxines, antitoxines, protective and curative serums, immunity, etc., reducing the subject to something like logical completeness. In this section we see much more than simple compilation of facts and can recognize the author's personality in the method of treatment. Even Prof. Hueppe, however, is not able to reduce this matter to anything like clear logic, since our present knowledge is so largely filled with lacunæ. At best, the matter of immunity and toxines must be left with many questions. It is impossible to read this discussion of toxines and antitoxines, nucleins, phagocytosis, active and passive immunity, etc., without having a better notion of the proper bearing of the different phases of the subject.

This work of Prof. Hueppe is useful to two classes of readers. Those who are not bacteriologists, but who desire to learn the general facts which the last quarter of a century has discovered, will find here a brief but intelligible summary. Those who are already familiar with the general facts will, perhaps, find the book of even more value in giving a clear and simplified conception of the various confusing facts which have so rapidly accumulated in recent years.

H. W. CONN.

SCIENTIFIC JOURNALS.

THE ASTROPHYSICAL JOURNAL, APRIL.

THE opening article, by Prof. J. Wilsing, contains a short discussion of previous papers on the law of the sun's rotation. The differential currents on the sun's surface are shown to be results of earlier conditions of motion, and can be destroyed by internal friction only. The least time in which changes of the surface currents would become perceptible is calculated to be millions of years.

In a report on solar observations for the second half of 1895, by Prof. Tacchini, there is shown a continued decrease in the number of spots, with a secondary minimum in November. There was a disproportionate decrease in prominences with a minimum in October.

In discussing the spectrum of Mars, Prof. Lewis E. Jewell contends that spectroscopic proof of the presence or absence of water in the atmosphere of Mars must be regarded as unattainable. With reference to oxygen, its presence might possibly be detected if present to the amount of a quarter that in the earth's atmosphere.

In an article on A New Form of Refractometer, Mr. C. Pulfrich describes one with a scope of application including almost all quantitative investigations on refraction and dispersions at varying temperatures. Its essential features consist of a 90° prism, one face of which, turned upward and made horizontal, is brought in contact with the object to be investigated, while through the vertical face is observed the boundary line limiting the light which, after passing through the object, enters the prism under grazing incidence.

The latest article in the series on the 'Modern Spectroscope' is by Professor Newall. It is a description of the new Bruce spectroscope constituted for the Cambridge observatory. The instrument is unique in being designed solely for photographing spectra of the fainter stars and in having no provision made for visual micrometric measurements. A single white-flint prism is used, giving a spectrum of 20mm. in length between $H\beta$ and K, or, with a telephoto-combination, a spectrum of about 44mm.

Other articles are, 'Light Curves of Variable Stars Determined Photometically,' by Edward C. Pickering; 'The Arc Spectra of Rhodium Ruthenium and Palladium,' by Henry A. Rowland and Robert R. Tatnall.

Among the minor contributions is found a concise summary of the properties of the X-rays and a comparison of them with those of light and cathode rays; and a recommendation that, in place of mercury as a reflecting surface for sextant and other work, a dark cylinder oil be used, such as may be procured of any locomotive engineer. It is freer from vibration, cheaper, lighter to carry, and easier to obtain in out-of-the-way places.

THE AMERICAN GEOLOGIST, MAY.

The Genus Temnocyon and a New Species thereof and the New Genus Hypotemnodon, from the John Day Miocene of Oregon: By JOHN EYERMAN. The new species described is *Temnocyon ferox*, of which a very complete and detailed description is given. The new genus *Hypotemnodon* is proposed for the reception of Cope's *Temnocyon coryphæus*.

Early Pleistocene Deposits of Northern Illinois: By O. H. HERSHEY. The author discusses the glacial geology of a part of northern Illinois, especially the Pecatonica valley, in which was formed a glacial lake named Lake Pecatonica.

On a Supposed Discovery of the Antennæ of Trilobites by Linnæus in 1759: By C. E. BEECHER. In the Geological Magazine for March, Törnquist calls attention to a discovery, by Linnæus, of the antennæ of *Parabolina spinulosa*, which has apparently been overlooked by later workers. Dr. Beecher not only shows that this discovery has not only been overlooked, but also that what Linnæus considered as antennæ are not antennæ at all.

The Deposition of Gold in South Africa: By S. CZYSZKOWSKI. (Translated by H. V. WINCHELL.) The theories advanced by de Launay, Jules Garnier and others to explain the origin of the auriferous beds of South Africa are not in all respects acceptable. Instead of the contemporaneous deposition of gold and mechanical sediments of conglomeratic nature it is held by M. Czyszkowski that the gold was introduced by mineral waters circulating through the porous strata subsequent to their consolidation, and as an accompaniment of a period of general earth movements and eruptive phenomena. The auriferous strata are believed to occupy synclinal basins in which the gold ores have been developed in favorable situations. Summarized descriptions of the geology of South Africa are given, and several comparisons are made between these ore deposits and those of Spain. The introduction of the gold is believed to have been of Carboniferous age, and prior to the formation of the Cape diamonds. From a more detailed discussion of the geological structure of the several Transvaal districts it is inferred, on the one hand, that the ore deposits may be far from inexhaustible; while, on the other hand, it is shown that there are many more geological conditions and other horizons which appear to be favorable for the concentration of gold ores, and where explorations may be conducted with profit.

Minerals and the Röntgen Rays: By W. G. MIL-

LER. The author presents some notes on X-ray photographs of minerals and thin sections of rocks; the article is accompanied by an illustration.

SOCIETIES AND ACADEMIES.

ACADEMY OF SCIENCE OF ST. LOUIS.

AT a meeting of the Academy on May 4th Prof. Nipher read a preliminary paper on *A Rotational Motion of the Cathode Disc of the Crookes Tube.*

He had been studying the change in the character of the Crookes effects due to long continued operation. It was observed that the cathode disc of aluminum was slightly loose, and that it was rocking to and fro in rotary motion on the aluminum wire. It finally became loosened and started into a slow rotation. The motion was a halting one, as the disc was out of balance and the bearings were rough. When stopped by pinching in the bearing, it began to struggle and rock against the restraint and would finally become loosened again and continue its motion.

It was impossible to either accelerate or retard the motion by powerful bar magnets, applied as in Barlow's wheel. Change in position with respect to the earth's field or the induction coil produced no effect on the rotation. Looking at the disc from the point where the cathode wire enters the tube, the disc rotates counter clockwise. The brush discharge of a Holtz machine yielded even better results than the induction coil when the leading conductors were separated by spark intervals.

The rotation has not yet been obtained between spark terminals in air of ordinary pressure nor when the movable disc forms the anode, but work on these points is not yet concluded.

Prof. Nipher stated that the experimental evidence thus far indicates that the effect is due to action and reaction between the cathode plate and the radiant matter. If so, the radiant matter starts from the disc in a vortex, whose axis passes through the dark spots opposite the disc faces. It may also be due to direct action and reaction between the disc and the surrounding field due to the current. He is now having apparatus constructed which will determine between the possible explanations. Prof. Nipher stated that he had long sought some experimental basis for imposing a condition of rotation upon the equations for force and potential within a wire conductor. Without such term the equations lead to absurd results.

Dr. E. C. Runge described an interesting case of insanity, unrecognized for twenty-eight years.

WILLIAM TRELEASE,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES.—SECTION OF ANTHROPOLOGY, PSYCHOLOGY AND PHILOLOGY.

THE Academy met on April 27th, with President Stevenson in the chair, and proceeded to organize the new Section in Anthropology, Psychology and Philology. Prof. N. M Butler was chosen temporary chairman.

Prof. F. H. Giddings was nominated and elected Permanent Chairman of the section; Dr. Livingston Farrand, Secretary of the sub-section of Anthropology and Psychology, and Prof. A. V. Williams Jackson, Secretary of the sub-section of Philology. The officers were elected for a term that will end at the annual meeting of the Academy, and it was resolved that the two sub-sections meet in alternate months.

Prof. F. H. Giddings read a paper on *A Plan for the Systematic Study of tribally organized Societies*, which will be printed in SCIENCE.

Prof. J. McKeen Cattell described a *Method for Determining Photometric Differences by the Time of Perception.* A series of gray surfaces was exhibited making over 200 nearly equal shades between black and white. The shades are so nearly alike that they cannot be distinguished with certainty, and when the observer attempts to sort them out in order an error of displacement occurs which measures his accuracy of discrimination. With nine observers the error varied from 6.04 to 11.05, the average being 8.1, from which it follows that about 25 shades can be distinguished between black and white. The relation of the error of observation to the brightness of the light was shown. The speaker further described experiments now being carried out with the same gray surfaces, in which the time it takes to distinguish the difference between two sensations is used to measure the amount of difference in intensity between the sensations.

Dr. Livingston Farrand, in a paper on *Primitive Education,* discussed methods of training and general education among primitive peoples in their bearings on primitive conceptions of morality, taking up the general condition of the child in the savage community and more particularly the relations of the child and parent.

The question of education was discussed under three heads: (1) the natural training which the child obtains by natural reaction on his environment and without definite instruction by his elders; (2) the practical education where the child is definitely instructed in the arts which will be of use to him in his later, life and (3) his ethical education. Attention was called to certain phases of the subject where observations are particularly faulty or altogether wanting.

Dr. Franz Boas spoke on the *Correlations of Anthropometric Measurements.* He pointed out that when any two biological measurements are considered as correlated, and individuals showing a certain value of the first measurement are grouped together, then the average of the values of the second measurement for the group of individuals will also be changed, but to a less degree than the first. When, however, the grouping of individuals is made according to social aspects, then all the measurements change either proportionately or according to laws differing from the one quoted before, the reason being that in the second grouping a certain set of causes influence all the measurements in the same manner. By applying this principle it is possible inversely to determine social causes that produce certain anthropometric peculiarities, as in groupings which are made according to the proportions and to the absolute values of measurements combined, the social classes will be represented in varying proportions.

LIVINGSTON FARRAND,
Secretary of Sub-section.

PROCEEDINGS OF THE TORREY BOTANICAL CLUB WEDNESDAY EVENING, APRIL 29, 1896.

THE Club met as usual in Hamilton Hall, with President Brown in the chair. There were present 64 persons.

Dr. Britton reported a successful field meeting at Prince's Bay, S. I., on April 25th, it being the first of the season.

Major Timothy E. Wilcox's paper, 'Botanizing in Arizona,' was then read. It was drawn from experience during four years residence at Fort Huachuca and was devoted to climate, seasons and topography, as well as descriptions of some of the little known plants of that locality. Botany was treated from an economic standpoint as well as otherwise. Lantern slides from original photographs were exhibited. Also slides showing other scenes were introduced.

Mr. Cornelius Van Brunt then rapidly showed a number of colored lantern slides of plants growing in Central Park, accompanying them with short descriptions and anecdotes. Most of these slides had not been exhibited before. Mr. Van Brunt described the method of coloring these slides by the use of aniline colors applied by hand.

W. A. BASTEDO,
Secretary pro. tem.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, APRIL 14, 1896.

On the Function and Systematic Importance of the Aptychus in Ammonites. By C. R. EASTMAN.

The speaker described the nature and mode of occurrence of the aptychus, and exhibited several specimens with the aptychus preserved in the so-called 'normal position' and also directly at the aperture. The numerous theories regarding its function were discussed, principal attention being paid to the nidamental and operculate theories. The Dundry, Crimean and Solenhofen specimens described by Owen, Retowski and Michael, respectively, were next discussed, and these were shown to prove, beyond all doubt, the operculate function of the aptychus. The fact that aptychi do not represent the calcified head cartilage of Dibranchiates was used as an argument against Ihering's proposition for associating Ammonites with the latter group. The viviparous habit of Ammonites, as indicated by the discovery of a number of minute aptychi and shells within the living chamber of *Oppelia steraspis* was commented upon, and attention called to the fact that in the Upper Jurassic Ammonites, which were then entering upon their decline, the development of the aptychus was initiated in the earliest shelled condition. The affinities between the Ammonites and Dibranchiates were shown to be on the whole very close, yet the evidence furnished by their internal structure and shell development is so strongly in favor of the Tetrabranchiate character of Ammonites that their separation from the Nautiloids seems at present unwarranted.

The Quartz Porphyry and Associated Rocks of Pequawket Mountain (the eastern 'Kearsarge' of New Hampshire). By R. A. Daly.

Both of the geological surveys of New Hampshire noted the presence of the remarkable flow breccia outcropping on what was long called 'Pequawket Mountain.' The second survey placed it in their table of formations under the name of the 'Pequawket Breccia.' The mountain is chiefly composed of a typical quartz porphyry in which inclusions of various rocks lie embedded. The object of this paper was primarily to present the results of an examination of a large number of microscopic slides prepared with the purpose of tracing the extent to which the inclusions had suffered from the metamorphism of the igneous body. The great slate mass on the south side of Kearsarge, is a gigantic horse in the poryhyry. It is about four hundred yards long from east to west and one hundred and fifty wide and lies close against the contact of the older 'Albany Granite.' On the border of the slate, severe brecciation has been produced, some phases being composed entirely of aggregated slate fragments, others with a variable proportion of quartz porphyry cement. Throughout the mountain small inclusions of the same phyllitic slate, from two feet to a fraction of an inch in diameter, are exceedingly numerous. Now, the striking fact in connection with them is the almost absolute lack of metamorphic change which has affected these fragments. The great horse of the south side does not betray any marginal alteration, except in the physical way already noted. This is a marked exception to the general conclusion of Lacroix that chemical rearrangement is usual in bodies enclosed within volcanic rocks of his 'trachytoïde' type. (Mem. de l' institut de France t. XXXI., 1894, p. 81.) It is all the more remarkable on account of the fact that the field-evidence shows the porphyry to be not a surface flow, but the filling of a neck where we should expect high temperatures and pressures and the presence of mineralizers to have produced extensive alteration.

The contemporaneous porphyry of Moat Mountain is in a similar tectonic relation and is likewise filled with inclusions of the same general nature as those of Kearsarge. Here also the metamorphism is almost *nil.* It is of interest to note that the base is not vitro-phyric as in the Kearsarge rock, but granophyric with accessory crystalline ingredients. Besides the phenocrystic quartzes and microperthitic feldspars, the rock is composed of a dense microgranitic matrix of quartz and feldspar, with abundant minute grains of hornblende, titanite, zircon, apatite and primary fluorite. This composition allies the rock closely to the 'Albany Granite,' which is, in part, the country rock of these porphyries.

The eruptions occurred after the last important White Mountain uplift. The eruptives are not squeezed, and their inclusions are, in part, derived from the crystalline schists, of the Montalban terranes. The slates, sandstones and phyllites probably represent masses which have sunk to their present level in the vent from the superficial zone of minimum metamorphism during the mountain building. It is, however, conceivable that they might have been carried up from a zone which lay below the level of no strain at the time of plication.

T. A. Jaggar, Jr.,
Recording Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

At the regular meeting, on April 25th, the following papers were presented, both being extensively illustrated with photographs of buildings in various parts of the world and plans and designs for the Capitol and Executive Mansion in Washington, the one by Wm. Martin Aiken on the 'Influence of Climate on Architecture,' and the other by Mr. Glenn Brown on 'Early Government Architecture.'

Bernard R. Green,
Secretary.

SCIENCE

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SCIENCE

FRIDAY, MAY 22, 1896.

CONTENTS:

MSS. intended for publication and books etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A SUCCESSFUL TRIAL OF THE AERODROME.

THE editor of SCIENCE has received the following letters containing an announcement of great scientific and practical importance:

THE EDITOR OF SCIENCE—*Dear Sir:* After having published some investigations in aerodynamics ('Experiments in Aerodynamics' and 'The Internal Work of the Wind'), I have made further experiments on the practical application of these conclusions, in the construction of an actual aerodrome or flying machine, upon a scale sufficient to admit of the employment of a steam engine of between one and two-horse power. I have never given any account of these experiments, as I have wished first to attain such a complete control of the flight as would insure its being automatically directed in a horizontal course, in any desired azimuth; but in view of the demands upon my time, which render it uncertain how far I can continue my personal attention to the completion of this object, I have yielded to the request of my valued friend, Mr. Graham Bell, to authorize the publication of a general statement of the results thus far obtained.

Let me add, in explanation, that the scale of the construction did not admit of any apparatus for condensing the steam or economizing the water, which, therefore, could only be carried in sufficient quantity for a very short flight. This difficulty is peculiar to the scale on which the experiment is conducted, and does not present itself in a larger construction.

Professor Bell has shown me his letter, which follows.

Very respectfully yours,

S. P. Langley.

Washington, D. C., May 12, 1896.

The Editor of Science—*Dear Sir:* Last Wednesday, May 6th, I witnessed a very remarkable experiment with Prof. Langley's aerodrome on the Potomac River; indeed, it seemed to me that the experiment was of such historical importance that it should be made public.

I am not at liberty to give an account of all the details, but the main facts I have Professor Langley's consent for giving you, and they are as follows:

The aerodrome or 'flying machine' in question, was of steel, driven by a steam engine. It resembled an enormous bird, soaring in the air with extreme regularity in large curves, sweeping steadily upward in a spiral path, the spirals with a diameter of perhaps 100 yards, until it reached a height of about 100 feet in the air at the end of a course of about half a mile, when the steam gave out, the propellors which had moved it stopped, and then, to my further surprise, the whole, instead of tumbling down, settled as slowly and gracefully as it is possible for any bird to do, touched the water without any damage, and was immediately picked out and ready to be tried again.

A second trial was like the first, except that the machine went in a different direction, moving in one continuous gentle ascent as it swung around in circles, like a great soaring bird. At one time it seemed to be in danger as its course carried it over a neighboring wooded promontory, but apprehension was immediately allayed as it passed 25 or 30 feet above the tops of the highest trees there, and ascending still further its steam finally gave out again, and it settled into the waters of the river, not quite a quarter of a mile from the point at which it arose.

No one could have witnessed these experiments without being convinced that the practicability of mechanical flight had been demonstrated.

Yours very truly,

Alexander Graham Bell.

1331 Connecticut Avenue,
Washington, D. C., May 12, 1896.

THE DEVELOPMENT OF EXOGENOUS STRUCTURE IN THE PALEOZOIC LYCOPODS—A SUMMARY OF THE RESEARCHES OF WILLIAMSON AND RENAULT.

The fact of the occurrence of exogenous structure in the Lycopodineæ, Equisetineæ and some of the ferns of the Carboniferous age is in itself hardly less remarkable and interesting than is the variety of phases under which this structure makes its appearance. It would seem that during the rapid differentiation and modification of vascular plants at the time of the great coal formation, plants of these lower classes played fast and loose with exogeny, shaping in fantastic and capricious designs a structure that is now the garb of the most exalted classes. Even within the boundaries of the *Lepidodendra* and the *Sigillariæ* the diversity is so great that while some species show no secondary growth at all, others, especially among the *Sigillariæ*, are so highly organized that the followers of the Brongniartian school still range them by the side of the Gymnosperms.

As representing the latest stage in the progress of knowledge concerning exogenous development in the Paleozoic Lycopods, as well as expressing the views of the foremost authorities in Paleozoic plant histology in both the Brongniartian and the English schools, I venture to summarize, in brief, without pretense of adding anything original to the subject myself, the contents of two lately published papers.

The first, by the late Prof. W. C. Williamson, of Owens College, England, his last independent publication, I believe, is entitled, *On the light thrown upon the question of the Growth and Development of the Carboniferous Arborescent Lepidodendra by a study of the details of their Organization.**

At the outset it may be well, and of interest to the reader, to briefly review the general structural characters of the Lepidodendron type, in describing which I shall quote in part from Prof. Williamson's own publications: "In the youngest Lepidodendroid twigs the conspicuous central tissue is a small vascular bundle known as the primary xylem strand. It extends, under varied modifications of form and size, from near the apex of the youngest twig to the base of the oldest stem. In its downward course it gives off a large number of small vascular bundles, known as leaf traces, each one of which passes outwards to a leaf, supplying it with its vascular tissues. In many cases we discover a few cells in the center of its component tracheids, which, on passing downward towards the lower members of the tree, enlarge into a more or less conspicuous medulla. In a few cases the smaller shoots exhibit no traces of these cells, which are only discoverable in branches of somewhat larger size; but in all, the larger the twig, the larger, also, is the central cellular tissue in varying degrees and in different types. This is a true medulla, which generally exhibits its maximum diameter only at the base of the oldest stems."

In the closest external contact to this primary xylem system is a second vascular zone, the 'secondary xylem,' which is developed from a peripheral cambium layer much like the growth of ordinary trees. This secondary xylem is composed of vertically prolonged radiating vascular laminæ, which are separated by intervening medullary rays. These two systems form the 'stele,' and the Carboniferous Lycopods are 'monostelic.' The remaining external zones of tissue constitute the leaf-bearing cortex. "In its youngest state this tissue consists almost wholly either of rounded cells, parenchyma, or vertically elongated ones with pointed ends, prosenchyma." At a later period of growth, varying in different types, a thin meristemic zone appears in the outermost parenchyma of the cortex. A ring of its rounded cells, as seen in transverse section, undergoes divisions, the more internal developing into prosenchymatous ones to form a layer of periderm. This periderm constantly thickens by similarly produced exterior additions so long as the plant lives, constituting the great bulk of the tree trunks, which may attain a diameter of four feet or more. The outermost cells resulting from the above-described meristemic action experience a succession of similar metamorphoses, always preserving a thin layer of parenchyma between the surface of the periderm and the bases of the leaves. The leaves, which are variable in form and size, are attached by rhomboidal bases to the bolsters or leaf cushions, which, though square and hardly larger than the leaf base when young, continue to grow after the true leaf falls off, and their diamond-shaped, often fusiform protuberant bolsters, arranged in quincunx, form the

*Mem. Proc. Manchester Lit. and Phil. Soc., 1894–95, pp. 31–65, 1895.

usual netted impressions characteristic and familiar in the fossil remains. The leaf scar bears three well-marked points. The Lepidodendra always branch dichotomously.

Concerning the mode of development of the primary xylem or central part of the stele there has been lack of evidence and consequent radical difference of opinion. To the solution of this problem Prof. Williamson devoted the six summer months of 1894 examining the slides in his extraordinary collection numbering several thousand specimens, and counting or calculating with great precision the number of cells in the primary and secondary xylem systems.

The study of the dichotomies of the branches has thrown great light upon this important question, for "It is to the ascending series of these dichotomies that the Lepidodendra owe their characteristic structure and modes of development."

The first change in the normally cylindrical ordinary branch is the splitting of the central vascular cylinder of primary xylem and its contained cellular medulla. The cylinder splits vertically for a short distance into two crescentic, diverging halves, while the external form of the branch becomes oval, the difference between the longer and shorter axes being greater as we ascend to the dichotomy. Before reaching this the two horns of each crescent of primary xylem approach each other. At this stage the cells of the two medullæ are in direct contact with those of the inner cortex. Several of Prof. Williamson's sections show that the crescentic condition is permanent for a short space at least, approximating what DuBary calls the 'foliar gap' in ferns. Higher in the dichotomy, however, the horns of each crescent rapidly converge to form two new cylinders, 'differing in no respects, save size and number of internal parts, from that of the parent stem.' The same phenomena occur with each successive dichotomy, each pair of resulting branches, though diminished in diameter, having exactly the same type of organization as the one from which they sprang. Thus, however numerous the dichotomies they are all produced alike and no structural changes are introduced 'from the base of the parent branch up to the smallest twig of the full-grown tree,' save certain secondary ones produced by growth processes which begin to manifest themselves at the base of that trunk. It will at once be seen that the number of cells and vessels of the cortex, primary xylem and medulla is one-half as great in each of the two branches as in the parent below the bifurcation. A similar ratio obtains in the number of leaves. Such dichotomies occur only when the twigs are terminal with a growing point.

Besides these equal dichotomies there are two sorts of unequal dichotomies different in structure and purpose. In the first only a small segment is cut out of the primary xylem cylinder and passes outward, carrying with it a small portion of the medulla to form a branch. This unsymmetrical segment becomes a solid strand with or without any trace of a medulla, though usually on reaching the axis of the cone, which it usually supports, a central medulla is shown. In the second form of unequal dichotomy the medulla is unaffected, a limited number of tracheids being detached from the periphery of the primary xylem cylinder. These strands may also go to reproductive organs.

In answer to the hitherto open problem as to how far the ordinary growth of a branch has exerted any influence upon or borne any relation to the varying dimensions of the primary xylem cylinder of the stele and upon the number of its component tracheids, the author's examination leads to this conclusion: "Unlike what occurs amongst the living Lycopods, amongst the Carboniferous Lepidodendra we find as we descend from the uppermost and youngest shoots, that there is a regular progressive enlargement of the branches below each succeeding dichotomy; * * * and these enlargements are accompanied by a similar though less conspicuous enlargement of the cylinder of the primary xylem, and also in the number of its component tracheids."

Prof. Williamson's examinations relate in particular to seven species of Lepidodendron.* Of these *L. Selaginoides* differs from other studied Lepidodendra in having the tracheids of the primary xylem, which are crowded at the outer periphery, more open and fewer in approaching the center of the system, where they often mingle with a peculiar barred parenchyma that occupies the place of the medullary cells in other species. In one specimen of this species the primary xylem has reached a diameter of nearly 3 mm., the cortical diameter being nearly 17 mm. before a small crescent of secondary xylem is discerned. At a more advanced stage the diameter of the primary xylem cylinder is 6 mm., the secondary xylem 14.5 mm., while the cortical is 92 mm.

Of *L. brevifolium*, which is remarkable for its frequent dichotomies, of both the equal and unequal types, Prof. Williamson obtained a section, below a dichotomy, in which a secondary xylem of a maximum thickness of 5 mm., invested the two tracheal crescents of primary xylem, the secondary xylem tissue being seen to grow around the horns of each of the primary xylem crescents and to push its way into the interior of their contained medullæ.

Exceptionally favorable conditions of preservation have made it possible to trace the development of the tissue in *L. Wunschianum* from the youngest twigs down to stems six feet in circumference. In this plant specimens in which the primary xylem is 4 mm. in diameter show no medulla, though on reaching a diameter of 5.5 mm. a medulla nearly 2.5 mm. in diameter appears. But the remarkable fact that the smallest stem in which a trace of secondary xylem was found showed the diameter of the cortex, primary xylem and of the medulla to be 23 cm., 36.5 mm. and 24 mm., respectively, while the very thin ring of secondary xylem is but 4 mm. thick on one side and 1 mm. thick on the other, demonstrates that the branches of this species attained a relatively large size before the growth of secondary xylem began.

In *L. Harcourtii*, the study of a section of which led Brongniart astray and began the conflict between the English and the French paleobotanists, the author elucidates several minor disputed points. It is noteworthy that no exogenous or secondary growth has yet been found by any of the investigators of this species, for the possible reason, as Williamson suggests, that the secondary xylem does not appear until a stage more advanced than that represented in any specimens yet examined.

Two of the sections of *L. fuliginosum* give the following diameters: 1st—cortex, 19 mm.; primary xylem, 3.5 mm.; medulla, 2 mm. 2d—cortex, 60 mm.; primary xylem, 7 mm.; medulla, 6 mm. At an advanced stage of growth, among the radial lines or cells of the innermost cortex, are found parallel lines of true tracheids, 'rudimentary representatives of the secondary xylem zone.' These cells pursue an irregular course longitudinally, and are unequally distributed in the cortical ring in which they occur.

* We can refer to but a few of the author's observations. Those who wish further data will find such tabulated in the present paper and illustrated in the magnificent series of memoirs 'On the Organization of the Fossil Plants of the Coal Measures,' published by Prof. Williamson during the last twenty-five years in the Transactions of the Royal Society of London.

The examination of numerous sections, including one only, 1 mm. in cortical diameter, of *L. mundum*, a low species, shows the same habit of development, and, in the descending from the smallest twigs to larger and lower branches, the same enlargement of the primary stele as a whole and of the number of its component tracheids as in the other arborescent forms.

The painstaking and exhaustive study of his remarkable series of sections led Prof. Williamson to abandon his earlier views, while approaching in the main to those set forth by Solms-Laubach in his Fossil Botany. The impossibility of intercalating leaves and leaf traces among the prearranged geometrically disposed spirals and the observed numerical progression of the volume of tracheids in passing downward lead to the inevitable conclusion that, unlike any living type of growth, these enormous developments of primary tissue originate at the base of the primary stem close to a growing point.

Here the chain of corroborative observation ends and the difficulties and further unsettled problems begin. Prof. Williamson adds: "As to the magnitude of the primary xylem strand and the enormous number of tracheids which compose it, these equally reached their largest proportion at the base of each solitary aërial stem. How such numbers of tracheids, varying in the type of *L. Wunschianum* from 4,000 to 15,000, could be produced in that position is difficult to understand. The *young* sporophyte could not possibly have contained them; hence some process of growth, of the nature of which we have as yet no knowledge, but which was capable of producing these marvelous results, must have succeeded, if not been developed out of the sporophyte."

The second paper, entitled *Sur l' utilité de l'étude des plantes fossiles au point de vue de l'évolution des organes*, is by M. B. Renault,* the leader of the French paleobotanical histologists.

M. Renault draws a very suggestive contrast between the present general grouping of living plants and what would be expected if the manifest relations of the fossil species were taken into consideration; for vegetable paleontology shows the existence of vast numbers of individuals presenting in different degrees characters intermediate to those which obtain among the living plants. If the fossils are included in the same classification with the living plants it will be difficult in many cases to establish perceptible demarcations between, and preserve intact the living groups.

As to the appearance of secondary growth and its use as a basis of classification, the author points out that such growth is seen first in the rhizomes, then in the stems, branches, leaves and fructifications respectively. Thus the subterranean stems of the living *Helminthostachys* and *Botrychium* show the secondary xylem while the aërial portions have the structure of the Cryptograms.

Lepidodendron Harcourtii (mentioned in Williamson's paper), *L. rhodumnense* and *L. esnotense* are cited as simple arborescent Lycopods, the trunks of which are without trace of secondary growth. *L. vasculare* and *L. selaginoides* show a secondary xylem cylinder of varying thickness in the stems. The *Stigmariæ* he considers more highly organized than the *Sigillariæ* which, according to the Brongniartian School, they bore. *Diploxylon*, regarded by some as a Lepidodendroid stage, by others as a *Sigillaria*, has a thick primary xylem surrounded by a bed of secondary xylem, the latter growth being found in not only the roots and stems, but in the foliar bundles also, as far as the base of the leaf.

The smooth Sigillarias, differing from *Di-*

* Bull. Soc. d'Hist. Nat. d'Autun, VI., 1893, Pp. 499–504.

ploxylon, especially by the marked diminution in the diameter of the primary xylem, exhibit the secondary growth in roots, stems and leaf bases, but only as an elementary stage in the leaf itself.

Representing the present Brongniartian School, M. Renault cites the somewhat anomalous *Poroxylon* group ('although belonging rather to another series leading to the Conifera') as examples showing the double growth in roots, stems and leaves, predicting that their still unknown fruits will probably be found to be small seeds constructed on the plan already observed in the contemporaneous *Gymnosperms*. If so, the *Poroxylon* will be especially exemplary in combining the characters of *Phanerogams* and *Cryptogams*. The 'libero-ligneous' bundle of the leaf has the double structure in *Colpoxylon*, while the structure is simple in *Medullosa*, a genus allied to the Cycads, though both have lost all traces of their centripetal wood, except some vascular bundles scattered through the pith, the woody element of the stem being composed of tracheids punctate in many rows and medullary rays organized like those of the *Cycads*. He concludes that the Phanerogamic characters became gradually associated with the Cryptogamic, increasing little by little to preponderancy and finally exterminating the latter; that these changes are successively accomplished in the principal organs of the plant and in a definite order, the fruits being last to change. In effect, M. Renault suggests that the difference between the Paleozoic Lycopod group and the living Cycad is hardly more than that between the living Cycad and the typical Phanerogam. DAVID WHITE.

THE EMBANKMENTS OF THE RIVER PO.

THERE is probably no part of the world in which the action of rivers in carrying and depositing sediment can be better seen and more readily studied than in the plains of Lombardy and along the adjacent shores of the Adriatic, and no district has contributed more to our knowledge of the important subject of river action and delta building than has this portion of Northern Italy.

In this well settled country the very rapid advance of the land upon the sea everywhere has been especially remarked and could not escape the attention of the most unobservant, since, as is well known, the very town of Adria, which gives its name to the Adriatic Sea and which was a sea port in the time of Augustus, now lies 14 miles inland.

One statement concerning the chief of these Lombard Rivers, the Po, taken from chapter eighteen of Lyell's Principles of Geology, has been copied and recopied in one generation of text-books after another, a statement so remarkable that wherever met with it always arrests one's attention. It is that in which, after speaking of the action of the dykes, between which these Lombard rivers are confined in causing a portion of the sediment, which would otherwise be spread over the plains by the annual inundations, to settle in the bottom of the river channel, with the consequent necessity of from time to time increasing the height of the dykes, he says, "Hence it happens that these streams now traverse the plains on the top of high mounds, like the water of aqueducts, and at Ferrara the surface of the Po has become more elevated than the roofs of the houses."

On reading this passage one cannot but tremble for the fate of the city should the river break through its dykes, as it has already done on several occasions, and, being precipitated into the city, tear its way headlong to the sea.

A visit to Ferrara toward the end of May last served, however, to show that this danger is less imminent than might be supposed from Lyell's description.

The city of Ferrara has seen its best days; its population once numbering 100,000 has now dwindled away to less than 30,000, while great stretches of land within the walls are now quite deserted or used as kitchen gardens. The broad and ample streets and fine squares, as well as the noble cathedral, the numerous palaces and the great castle of the House of Este, however, serve to remind us of the former greatness of the city, with which are so intimately associated a number of the most distinguished names in Italian history, Savonarola, Ariosto and Tasso among the number.

The city is situated in the middle of the great plain of lower Lombardy, which so far as the eye can judge, is absolutely flat and which here is only six and a-half feet above sea level. The walls of the city, built of brick—for no good building stone is to be had in the alluvial plains in this vicinity—rise abruptly from the plain and are of no great height.

The plain all about Ferrara is very fertile, well cultivated and of extreme beauty, being intersected at regular intervals by long lines of poplars and pollarded elms festooned with vines, which also border the roads and separate the meadows and great fields of grain and hemp. The roads crossing the plains are well made and are raised considerably above its general surface, thus keeping them dry and in good condition.

The river Po, however, does not pass through the city of Ferrara, although it formerly passed near the city and in this vicinity branched, forming the Po Primario, whose mouth was at Ravenna, and the Po Volano, which debouched into the northern portion of lagoon of Comacchio. In the year 1152, however, the river broke through its dykes at Stellata, twelve miles and a half northeast of Ferrara and took a new course in the direction of the Venetian lagoons, which course, with some minor modifications, it has retained to the present time. By this change the Po Primario and the Po Volano were deprived of a great portion of their water, and the main stream now passes three miles and a half to the north of Ferrara, where it is crossed by the railway to Padua, at the little town of Ponte Lago Scuro, a busy little place, which is the chief port on the lower reaches of Po and which is connected by a bridge of boats with S. M. Maddelena, a village on the opposite bank of the river.

On approaching Ponte Lago Scuro from Ferrara the dykes which confine the river are first seen, crossing the flat country like a wall. The road at Ponte Lago Scuro is carried by a long incline nearly to the top of the dyke, the upper portion of which is cut through to allow the road to pass, and then by a steep descent on the inner side of the dyke the bridge of boats is reached, after crossing, which, by a steep rise and then a gentle descent, the plain beyond the river is once more gained.

The Po at this point is 285 yards wide, with a swift current sweeping rapidly by the boats, and the water at the time of my visit was very turbid from suspended mud, although it did not appear so turbid as the Arno at Florence or Pisa, and certainly not so muddy as the Missouri at Bismarck.

Watching it from the bridge as it sweeps by already near the sea and far from its source on Monte Viso, carrying great quantities of leaves, masses of weeds and branches of trees floating on its surface, a very vivid impression of the work which is being accomplished by the river is obtained. Although nothing in the way of actual erosion can be seen, no mountains or rising ground anywhere breaking the monotony of the plains. The long sand bars, seen from the top of the dykes, in the wider stretches of the river just above Ponte Lago Scuro, show that in flood time a large quantity of material too heavy to be carried in suspension is swept along.

The dykes or embankments which confine the river on either side are about 25 yards wide and rise in two, or sometimes three, terraces as approached either from the plain or from the river, as if a wide dyke of moderate height had just been made, along the summit of which a narrower dyke had subsequently been raised. The height of the dykes was estimated to be about 26 feet, and being well grassed over they do not present that strikingly artificial character which might be expected. An excellent road runs along the summit of the southern dyke. The dykes thus, although not so high as the majority of the houses in the villages on either side, overtop the smaller houses and outbuildings, while, standing on the bridge at the middle of the river, seven feet above the level of the stream, only the roofs and upper stories of the buildings on either side of the river can be seen.

With regard to the level of the waters of the Po as compared with that of the adjacent plains many contradictory statements have been made. The statement of Lyell that at Ferrara it was as high as the roofs of the houses was derived from Cuvier's 'Discours sur les Révolutions de la Surface du Globe,' although not quoted quite correctly, where the statement is made on the authority of M. de Prony, an Inspector-General of Bridges and Roads, who had been directed by the goverment to investigate the means of preventing the disastrous floods caused from time to time by the Po overflowing its banks.

These very old observations were subsequently shown by Lombardini in 1847 to be erroneous. This observer proved by accurate measurements that, at the time these were carried out, the mean height of the Po only here and there rose above the level of the plains and was generally considerably below it, and that even during the great flood in 1830 the surface of the river was scarcely ten feet above the pavement in front of the Palace at Ferrara (Geikie, Text-book of Geology, p. 368).

Since this time, however, these conditions have altered in a marked manner, the more recent investigations of Zollikofer having shown that in the normal condition of the river the surface of the water in the neighborhood of Ferrara is somewhat over 8 feet above the surrounding plains, while in flood time the water in some places rises from 16 to nearly 20 feet above the plain on either side (Kovatsch—'Die Versandung von Venedig'—Leipzig, 1882, p. 35).

At the time of my visit the surface of the water was certainly higher than the level of the plains, and the deep furrows in the dyke on the left bank of the river showed that in flood time the river now rises at least as high as the top of the first terrace of the embankment, which would be equivalent to the height given above by Zollikofer. That the river at times threatens to rise even higher is shown by the fact that where the upper terrace of the dyke is cut through to allow the passage of the road from Ferrara a brick wall has been constructed, so arranged that by the insertion of planks the highest level of the dyke may be maintained.

The city of Ferrara, therefore, although it might be subjected to disastrous inundation should the dyke on the right bank of the river break, is not so seriously threatened as might be inferred from Lyell's statement, and the Po, which in flood time 'hangs suspended, so to speak, over the surrounding plains,' is now much less dreaded than in times past, owing to the irrigating channels which tap it, as well as to a secondary series of lateral embankments which, placed at a considerable distance from the dykes on either side, border the whole course of the river below Cremona.

FRANK D. ADAMS.

McGILL UNIVERSITY, April, 1896.

MEASURING HALLUCINATIONS.

IN SCIENCE, 1893, XXII, 353, attention was called to a method of measuring the intensities of hallucinations. The method is, in brief, as follows:

In an unsuspecting subject the stimulus R under the condition P is used to produce a sensation S. The sensation is a function of the stimulus, $S=f(R)$, and is measured by means of it. By means of appropriate adjustment of the conditions P the sensation can be made to appear just the same whether is present or not.

When R is not present, the sensation is called a hallucination; let it be denoted by the H, although the person experimented upon does not distinguish sensation from hallucination. We have thus in such cases $H=S$, and likewise $S=f(R)$, with R used measure the intensity of the hallucination. It is also evident that $H=F(P)$, and likewise (a fact seldom fully regarded in psychology) $S=F(P)$.

With this method Dr. C. E. Seashore has, under my guidance, carried out measurements of hallucinations and has just published the results in the *Studies from the Yale Psychological Laboratory* for 1895. As the fundamental idea may interest others than those reached by the *Studies*, I will state it briefly here.

It was at first intended to end every experiment in a measurement according to an absolute scale of units of energy, *e. g.*, light by reference to a standard source of illumination or to a bolometer-reaction (LANGLEY, Mem. Nat. Acad. Sci., 1891, V, 7), sound in units of atmospheric displacement (WIEN, Wied. Ann., 1889, XXXVI, 834), etc.; but it was soon decided that it was preferable to first explore the region of suggestion and hallucination with convenient arbitrary scales without waiting to reduce these scales to standards. This course has been amply justified by the results; the proper methods of producing hallucinations have been found for all the senses and the arbitrary scales have been so arranged that future investigators can repeat the experiments under exactly the same conditions, merely changing the scale. To be sure, this latter step is generally very expensive in many ways; in our case width of exploration was preferable to minuteness.

A typical case of the application of the method is found in measuring hallucinations of sound. The person experimented upon was placed in a quiet room and was told that when a telegraph sounder clicked, a very faint tone would be turned on, and that this tone would be slowly increased in intensity. As soon as he heard it, he was to press a telegraph key. The experimenter in a distant room had a means of producing a tone of any intensity in the quiet room. The apparatus for producing the tone consisted in an electric fork interrupting the primary circuit of an inductorium in the experiment room and a telephone in the quiet room (unknown to the subject), which was in connection with the secondary coil of the inductorium. The intensity of the tone depended on the distance between the two coils of the inductorium; this distance was recorded in millimeters.

In the first few experiments a tone would be actually produced every time the sounder clicked, but after that the tone was not necessary. It was sufficient to click the sounder in order to produce a pure hallucination.

The persons experimented on did not know they were deceived, and said that all tones were of the same intensity. The real tone could be measured in its intensity, and since the hallucination was of the same intensity it was also indirectly measured.

Similar experiments were made on other senses. For example, in regard to touch, a light pith ball would be dropped regularly on the back of the hand to the sound of the metronome. After a few times it was not necessary to drop the ball. The person would feel the touch by pure hallucination.

Similar experiments were made on taste. Of six bottles two contained pure water and the other four a series of solutions of pure cane sugar—the first one-half per cent., the second ten per cent, the third two per cent. and the fourth four per cent. sugar, according to weight. A block was placed in front of them so that the observer could not see them, although he was aware that they stood near him, because he saw them when he received his instructions. It was required of him to tell how weak a solution of sugar he could positively detect.

The experimenter took a glass dropper and deposited drops on his tongue, drawing first from the two water bottles, and then from the sugar solutions, in order of increasing strength. The sugar in the solutions was detected in the first trial. Proposing to repeat the test, the experimenter proceeded as before, but drew from the first water bottle every time. The result was that when the pure water had been tasted from two to ten times the observer almost without exception thought he detected sugar.

A test on olfactory hallucinations was conducted similarly, with the result that about three-fourths of the persons experimented upon perceived the smell of oil of cloves from a pure water bottle.

In another set of experiments the subject was told to walk slowly forward till he could detect a spot within a white ring. As soon as he did so, he read off the distance on a tape measure at his side. The spot was a small blue bead. The experiment was repeated a number of times. Thereafter the bead was removed, but the suggestion of having previously traversed a cartain distance was sufficient to produce a hallucination of the bead.

The investigation was carried out in various problems of hallucination and suggestion ; in each problem the work was kept up till the appropriate method of producing hallucinations was found. I cannot here go into the details of Dr. Seashore's experiments, but the fundamental idea is, I hope, clear.

The surrounding and internal conditions P were of a given character in the first experiment, namely, definite place, apparatus, expectation, etc. The sensation S resulted from R. Each repetition of the experiment produced a change in the attitude of expectation ; P was consequently changing. Finally, the production of a given value of P was sufficient to entirely replace R in producing the sensation.

It is to be clearly understood that the persons experimented upon were perfectly sane and normal. They were friends or students, generally in total ignorance of the subject, who supposed themselves to be undergoing some tests for sensation. One case was found, however, of a suspicious observer who expected deception and who declared that he had waited every time till he was sure of the sensations; the results were just as hallucinatory as usual.

The value of the method and the experiments lies mainly, I think, 1, in pointing out a method of determining the portion of a sensation due to the suggestion of circumstances rather than to the stimulus; 2, in application to mental pathology; 3, in beginning a scientific treatment of hypnotism and suggestion. E. W. SCRIPTURE.

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LIFE HABITS OF PHRYNOSOMA.

IN a recent number of the 'Zoölogischen Anzeiger' Prof. Charles L. Edwards, of the University of Cincinnati, gives the following interesting notes upon the habits of the horned lizard of Texas:

While living in Austin, Texas, from

May, 1892, to July, 1894, I had abundant opportunity of verifying previous observations upon the life of *Phrynosoma*, and of adding some notes that, so far as I can find, have not been given before this paper.

Phrynosoma cornutum Harlan, in Texan parlance the 'horny frog,' is easily approached under the natural conditions of its habitat, and with a plentiful supply of live flies I have had no difficulty in keeping from fifty to one hundred of them confined in vivaria for many weeks at a time. Six months of the hot, dry, Texas summer, with long days under the glaring sun, and the ground covered with a layer of fine, limestone dust, gives this species of *Phrynosoma* an ideal environment.

A review of the principal points concerning the biology of this familiar genus as brought out in the literature appended, and confirmed by myself, may be first presented. Not to go back to the original systematic descriptions of Wiegmann, Girard, Harlan, Hallowell, Bell, Gray and Blainville, or to mention the synonymy from the various catalogues of reptiles, the taxonomic needs of this paper may be served by reference to Gentry's review of the genus *Phrynosoma.*

This cunning little Iguanid is harmless, never biting its captor, and soon becoming so tame that it may be trained to work in harness pulling a toy wagon, or to eat insects from one's hand. When gently rubbed it puffs itself out, but when in fear it becomes flattened to the ground. *Phrynosoma* chiefly enjoys a dust heap, where with tail and feet flirting the warm calcareous powder over its body, or with alternate sawing motions of its sides, it quickly buries all of itself save the head, and sometimes even this part, in the dirt. While built after an awkward pattern for a lizard, and generally moving slowly, yet it can, when alarmed, run rapidly. It is very clever at 'playing possum' and, aided by its protective coloring, often escapes from an enemy.

The food of *Phrynosoma* always consists of live animals—spiders, flies and especially ants. In Texas the agricultural ant (*Pogonomyrmex barbatus*) furnishes almost exclusively the diet of the horned frog. If, however, a quantity of ants are placed with the latter in a vivarium, they soon find thin places on the apparently tough, horny armor of their enemies, and by stinging they drive the horned frogs crazy and frequently to death. While having an abundant supply of water in the vivarium, I have never seen these lizards drink, although they are said to lap up drops of dew when in natural environment. The molting and the curious habit of ejecting blood from the eyes are phenomena often observed. The statement of Böttger that a voice is absent in *Phrynosoma* must be modified, for under certain conditions of excitement it utters a sharp squeak.

This lizard has always been given as viviparous. On the contrary, it builds a nest and lays eggs therein. The only time I observed the nest-building was on June 25, 1894. The location was on a stony clay bank at the side of an Austin street. When first seen, 6 p. m., the female was excavating a tunnel at an angle of about 75° to the surface of the ground, and wide and high enough to comfortably work in. She dug with her front feet, pushing back the loose earth and bits of stone with her hind feet until this débris was quite clear of the entrance. So absorbed was she in her work that my presence did not cause any alarm. The next morning I found the tunnel neatly filled again and the lizard gone.

After carefully removing the replaced débris, the tunnel was found to be seven inches deep. At the bottom, forming an L with this tunnel, was a narrow entrance leading into a chamber three and one-half inches in diameter and two inches high, which was quite round, except for two projecting stones. Here perfectly packed in with loose earth were twenty-five eggs, while again in a hole one and one-half inches deep, at the bottom of the tunnel, were fifteen more. Since the embryos of one of these sets were at a considerably more advanced stage, this female must have taken advantage of the excavation of another. At the time of ovulation the embryo, while at an advanced stage, is still not ready to hatch by probably some days or even weeks. This stage will be considered in detail in a later paper on the embryology of *Phrynosoma*.

Authors give the period of gestation as high as one hundred days in females kept in confinement, but while I have not complete data from coition to ovulation I believe that under natural conditions the time of carrying the eggs is much shorter. A female which had laid eggs in captivity in August, 1864, became very restless after the eggs were taken away. She tried constantly for two or three days to get out of the vivarium at the place where the wire screen had been raised to remove the eggs. Lockwood gives an instance of this maternal anxiety where a female attempts to distract the attention of an observor from her young.

LORD KELVIN ON THE METRIC SYSTEM.

THE chief objection urged in the recent debates in Congress against the adoption of the metric system in the United States was the fact that Great Britain, with whom our commerce is the largest, does not use the system. It seems, however, certain that the adoption of the system by both nations is only a matter of time, and as the question is now being considered, both by the British Parliament and our Congress, it would be highly desireable if an International Commission could be arranged so that unity of action could be secured by the two nations.

The London *Times*, whose influence has been said to be as great as that of Parliament, has recently given much space to discussion of the metric system. Of the large number of letters addressed to the editor we quote the following from Lord Kelvin as of special interest:

"In your very interesting leading article on the metric system in *The Times* of yesterday you treat, in what seems to me a thoroughly clear and fair manner, the question at issue in respect to the demand for legislation on the subject.

"While not ignoring the preference or merchants and manufacturers and scientific men for the metric system, you rightly give prominence to consideration for the convenience of the poorer classes, 'who have no great power to make their voices heard—at least in such discussions as these.' If it were true that the adoption of the metric system would be hurtful, or even seriously inconvenient, to them, that would be a strong reason against its being adopted in England. But in this respect we have, happily, a very large experience, and I believe it is quite certain that among the Germans, Italians, Portuguese, and other European peoples who have had the practical wisdom to follow the French in the metric system, all classes are thoroughly contented with it, and find it much more convenient for every-day use than the systems which they abandoned in adopting it.

"You rightly brush aside the duodecimal system as 'an ingenious mathematical exercise, but one whose figures must be read back into a decimal system before they can convey any meaning.' It seems to me, however, that you are quite right in maintaining that in ordinary every-day reckonings the shopkeeper and his customers must have halves and quarters; but I cannot go so far with you as to say 'halves, quarters and thirds.' Was any poor child ever sent to buy a third of a pound of tea? Did any thirsty traveller, other than a mathematician, ever ask for a third of a quart of beer? It may be taken as a practical result of natural selection, permanent through thousands of years, that halves and quarters of the ordinary unit for any class of measurement are natural and convenient.

"In the metric system we find the kilogramme, half-kilogramme and quarter-kilogramme continually used in weighing. There is no obligation to always call the half-kilogramme 500 grammes, or the quarter-kilogramme 250 grammes. For smaller quantities the gramme is a thoroughly convenient measure. For distances travelled we have the kilomètre, half-kilomètre and quarter-kilomètre. For measuring cloths, ribands and tapes, in retail shops, we have the mètre and centimètre, which are thoroughly convenient and popular for all ordinary use. The centimètre (about four-tenths of an inch) is a thoroughly convenient smallest unit for most practical purposes; and for finer measurements the workman under the metric system has a great advantage in the millimètre and half or quarter millimètre over the British workman with his troublesome and fatiguing eighths, sixteenths, thirty-seconds and sixty-fourths of an inch.

"The great advantage of the metric system is its uniform simplicity, all measurements of length, area, volume and weight being founded primarily on the kilomètre. The kilomètre is very convenient for measuring great distances on the earth's surface, because a journey a quarter round the world is nearly enough 10,000 kilomètres for almost all practical purposes. If our travelling was habitually, not on the earth's surface, but along diameters through the centre, there would be some practical value in the merit discovered for the British inch by Sir John Herschel that it is approximately one one-hundred-millionth of a diameter of the earth.

"The thousandth of the French ton is the kilogramme; and the cubic decimètre, or the thousandth of the cubic mètre, is the litre, which is the common popular unit for liquid measure; so that any one who has correct weights can verify for himself his litres or other measures for liquid. This particular merit of the metric system, which, so far as I know, has not been much, if at all, noticed by your correspondents, is of very great importance in mechanics and engineering. In virtue of it the weight of any quantity of material is found in tons, or in kilogrammes, or in grammes, simply by multiplying its volume in cubic mètres, or in cubic decimètres, or in cubic centimètres, by its specific gravity; and thus a very great deal of labor which is entailed upon mechanical engineers, civil engineers and surveyors in England under the present system will be done away with when the metric system comes into use.

"But now, considering the wants and the convenience of the whole population, think of the vast contrast between the practically valuable simplicity of the metric system and the truly monstrous complexity of British measurements in miles, furlongs, chains, poles, yards, feet, inches; square miles, acres, square yards, square feet, square inches; cubic yards, gallons, quarts, pints, gills; tons, hundredweights, quarters, stones, pounds, avoirdupois (7,000 grains), ounces avoirdupois (437·5 grains), drams avoirdupois (27·34375 grains), pounds troy (5,760 grains), ounces troy (480 grains), drams apothecaries' (60 grains), &c. Looking at the question from all sides, and considering all the circumstances, I believe it will be found that the thorough introduction of the metric system, for general use in Great Britain, will be beneficial to all classes; and that the benefit will, in the course of a few weeks, be found to more than compensate any trouble involved in making the change."

NOTES ON AGRICULTURE AND HORTICULTURE.

PREVENTION OF SMUT IN OATS.

THERE is a large loss annually from smut in various crops and oats especially suffers. It was about twenty per cent. at the farm of the Ohio Station, and a fair estimate of loss for the whole United States is more than eighteen millions of dollars annually.

This smutting of the grain, as has long been known, is due to an invading fungus that produces vast multitudes of spores in the grains; in short, the grains are transformed or replaced by the fungus which in its final condition is mostly spores usually dark and dusty.

Prof. Selby shows by his experiments that the smut enters the seedling oat plant by spores adhering to the seed grain and may be prevented by the destruction of the spores attached to the oats before sowing. This may be done by immersing the oats in hot water at a temperature of 133° F. for fifteen minutes. This treatment likewise increases the vigor of the seed. It was also found that "soaking the seed for twenty-four hours in a solution of a $\frac{3}{4}$ per cent. solution of potassium sulphide made by dissolving $1\frac{1}{2}$ pounds of the salt in 25 gallons of water is equally efficient in smut prevention." Both the above methods of treatment apply to wheat, barley and other grains, with certain modifications to suit the particular cases.

BACTERIOSIS OF CARNATIONS.

BACTERIOSIS is a term now growing into general use for the disease in plants due to bacteria. There are several of these troubles caused by micro-organisms, but none more interesting to the mycologist than that of the carnation. Dr. Arthur and Prof. Bolley conjointly have issued the results of their studies in a neat bulletin (No. 59) from the Indiana Experiment Station.

This bacteriosis is widespread among carnations and while seated in the leaves checks the growth of the whole plant. The disease germs enter the plant through the stomates, punctures of insects or by dissolving a passageway in the cellulose through the action of an enzym. The methods of isolating the germs of the *Bacterium Dianthi* Arth. & Boll. n. sp. are given. A full page heliotype plate is presented of gelatine tubes and another of the appearance of a portion of a diseased plant. It is found that any variety of carnation may be affected, but weak and old plants are most susceptible. Other than members of the pink family of plants are exempt from this trouble.

Valuable practical methods of culture to prevent the bacteriosis have been found, the chief ones residing in the fact that the disease is favored by moisture. By keeping the foliage dry, by watering the soil between rows of wire netting arranged to support the plants the disease is largely prevented. The aphis should be kept off.

BYRON D. HALSTED.

NEW BRUNSWICK, N. J.

CURRENT NOTES ON ANTHROPOLOGY.

RACE AND DISEASE.

SOME interesting studies on the relations of these factors in sociology have recently appeared from the pen of Dr. William Z. Ripley, who lectures on anthropo-geography in Columbia College. One is upon the problems of acclimatization, and may be found in the March and April numbers of the *Popular Science Monthly* It displays a thorough acquaintance with the literature of the subject, and is marked by a careful weighing of the numerous discordant opinions. It cannot be said that he reaches a satisfactory decision in favor of the possibility of acclimatizing the white race in the tropics, which is the chief practical interest of the inquiry.

Another of Dr. Ripley's papers appears

in the March number of the quarterly publications of the American Statistical Association. It is upon ethnic influences in vital statistics, illustrated by a comparison of the Walloon and Flemish inhabitants of Belgium. The facts presented are interesting and from the best obtainable sources; but the complexity of the problem is enormous, and after one has excluded all other possible or probable explanations for the diversity discovered, very little is left which can be strictly called ethnic. For instance, the birth rates, the excess of male infants and the infant mortality may have quite other explanations than those connected with ethnic contrasts.

BUDDHA-LIKE FIGURES IN AMERICA AND ELSEWHERE.

In Egypt, in Greece and abundantly in France, representations of deities seated cross-legged have been found, and frequently by archæologists have been referred to as Buddhistic or Buddha-like figures. In the museum of the Trocadero, Paris, there are a number of such in terra cotta from Chiapas; and at Palenque the cross-legged divinity has been pictured by Stephens (Travels, vol. II, p. 318) and others. Of course, these have been utilized as evidence of Buddhistic influence in North America and Europe.

A severe blow at such illusions is dealt by M. H. Galiment in the Revue de l'Ecole d'Anthropologie (Feb. 15), in an article on 'the oriental attitude of divinities.' By this he means merely the ordinary oriental method of sitting which is common also to our tailors and to many non-oriental nations. This he sharply distinguishes from the religious attitude assigned to the Buddhas. In the latter the legs are crossed, and each foot rests on the thigh of the opposite leg, with the sole turned upward and in full view. This is quite different from the attitude in any of the American specimens known to me, either by observation or by copies. They are seated with the legs crossed beneath the thighs, in the ordinary sartorial position. Thus does another prop fall from the weak structure of the builders of American aboriginal culture on Asiatic foundations.

CURRENT NOTES ON METEOROLOGY.

HURRICANES IN JAMAICA.

A chronological list of hurricanes, earthquakes, and other physical occurrences noted in Jamaica between 1504 and 1880, is given by Maxwell Hall in Vol. II. of the *Jamaica Meteorological Observations* (1896). The first great hurricane experienced by the English in Jamaica was on August 28, 1712, and on August 28, 1722, another very violent one occurred, which resulted in the loss of about 400 lives and the wrecking of forty-four vessels in the harbor of Port Royal. In order that these two visitations might be remembered by the inhabitants, August 28th was appointed to be kept as a perpetual fast by the Act 9 Geo. I., ch. I., passed in 1722. On June 3, 1770, there was a smart shock of earthquake, which was immediately preceded at Cape François by a fall of 2.5 in. in the water barometer, corresponding to a fall of 0.2 in. in the mercurial barometer. Small oscillations of this character have since been noticed at Kingston as accompanying earthquake shocks.

Previous to the hurricane of October 3, 1770, a noise resembling the roar of distant thunder was heard to issue from the bottom of all the wells in the neighborhood of Kingston, twenty hours before the commencement of the storm. A ship captain who noted this fact, and who was informed that it was a prognostic of an approaching hurricane, managed to get his ship into the inner harbor in time to save her from destruction.

THE CLIMATE OF VENEZUELA.

SOME notes on the Venezuelan climate are quite in place at the present time. Three climatic zones are recognized: The *tierra caliente*, extending from sea level to about 1,800 feet, with a mean temperature of 77° to 86° F.; the *tierra templada*, reaching up to about 7,200 feet, with a mean temperature of 60° to 77° F., and the *tierra fria*, above 7,200 feet, with a mean temperature below 60° F. The heat on the northern coast is excessive, owing to the trade wind, which blows on shore there after crossing the hot Caribbean Sea. Maracaibo, which has the reputation of being the hottest place in the world, is on this northern coast, while Caracas, at an elevation of 3,000 feet above sea level, is in the *tierra templada* and enjoys a cooler and more agreeable climate. The maximum temperature is between 68° and 82° in the hot months, and 52° and 71° in the cool months. In Acarigua, south of the Portuguesa range, a temperature of 125.5° has been reached in the sun and 89.5° in the shade. The climate is, as a whole, healthy. Yellow fever prevails near the coast and in the Llanos and forests of the lowlands, and sometimes visits towns in the *tierra templada*. The higher mountains are free from it and have a very healthy climate. The foregoing facts are taken from a paper on Venezuela in the *Scottish Geographical Magazine* for April, 1896.

A QUICK VOYAGE ACROSS THE PACIFIC.

THE May *Pilot Chart of the North Pacific Ocean* contains mention of a remarkable passage recently made from Shanghai to Port Townsend by the American schooner 'Aida,' the time from port to port being only 27 days. During the greater part of the voyage the wind was between north and west, and on three days blew with the force of a whole gale. The 'Aida' started in the western half of a cyclonic depression central over Japan, and hence experienced northwesterly winds for several days. These were followed by southerly winds of considerable force, due to the approach from the west of another cyclonic storm. The last few days she had southwesterly winds from an anti-cyclone central in Lat. 40° N., Long. 135° W., this high pressure area diverting the preceding cyclone to the northward and thus preventing the 'Aida' from experiencing the northwest gales on its rear. This passage of the 'Aida' may be regarded as an excellent example of what may be accomplished by a well-found sailing vessel whose master makes the most of the meteorological conditions prevailing over the ocean, and of the information now available concerning them.

A TORNADO IN NEW JERSEY.

TORNADOES are of such infrequent occurrence in the eastern United States that accounts of them, when they do occur, are of special interest. On July 13, 1895, a distinct tornado developed near Cherry Hill, N. J., causing the death of three persons, injuring about twenty others and entailing a loss to property, livestock, etc., of about $60,000 (6th Annual Report, New Jersey weather service, 1895, 203–208). It appears that while the general characteristics of tornado action were present, such as the funnel cloud, the whirling, the roar and the thunderstorm, the usual atmospheric conditions which precede such storms were lacking. A number of curious tricks were performed by the tornado, after the usual fashion of these disturbances. In the Dutch Reformed Church, whose sides and windows were punctured with holes, a large beam was found lying across the pews, it having been blown there from outside. A splinter of wood, 15 inches long, 2 inches square at one end, and tapering to a point at the other, was found firmly stuck into a fence post. A number of excellent photographic views accompany this report.

R. DeC. WARD.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

ANNUAL REPORT OF THE GEOLOGICAL SURVEY.

THE Fifteenth Annual Report of the United States Geological Survey has just been delivered by the Public Printer. It is a handsome volume of 755 pages and 48 plates, and contains, besides the administrative reports of the Director himself and of chiefs in charge of work, the following special papers:

'Preliminary Report on the Geology of the Common Roads of the United States,' by Prof. N. S. Shaler; 'The Potomac Formation,' by Prof. L. F. Ward; 'Sketch of the Geology of the San Francisco Peninsula,' by Andrew C. Lawson; 'Preliminary Report on the Marquette Iron-bearing District of Michigan,' by Prof. C. R. Van Hise, W. S. Bayley and H. L. Smyth; and 'The Origin and Relation of Central Maryland Granites,' by C. R. Keyes, with an 'Introduction on the General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau,' by the late Prof. G. H. Williams.

From these titles it is evident that the paper of most popular interest is the first one, on roads, by the versatile Harvard professor. He treats of the history of American roads, the methods of using stone in road-building, the relative value of road stones, their distribution, sources of supply, etc.; and thus makes a timely contribution to a subject which is receiving special attention in all parts of the country.

This is the last report made by Major J. W. Powell as Director of the Survey, who until recently has had charge of the work, under different organizations, for twenty-five years.

FISH CULTURE.

IN a lecture on fish culture before the Royal Institution of Great Britain, Mr. J. J. Armistead, of the Royal Commission on Tweed and Solway Fisheries, thus compares the methods used in Great Britain and the United States:

The hatching apparatus which is now chiefly used in England consists of a long box, the water flowing in at one end protected by a water board or break water, which is simply to break the current and prevent it from washing away the eggs which are placed in the box. It also diverts the current and sends it down to the bottom of the box. The water passes underneath and passes out at a higher level, where we have a screen of perforated metal to prevent the escape of the little fish, and in this box is placed the hatching apparatus proper, that is, the trays or grilles upon which the ova are deposited. The grilles now in use are made of glass. We found, after trying a variety of substances, that glass is the best of anything. It gives off nothing. Wood and metal we know corrode in water, and in some waters some metals corrode very much, and a great deal of loss has been suffered by some who have used metallic trays for the purposes of incubation. The Americans like to do things, as we know, on a wholesale scale, and, not content with putting a layer of eggs upon the apparatus, they fill a basket, as they call it, half full of eggs. Then they send a current of water welling up from underneath, and of course the effect is that it flows through amongst the eggs, and they find that in due time they hatch. I have made very careful inquiries with regard to the result of the hatching of ova in this way, and I have found that the Americans are quite prepared to admit that they had a larger percentage of mortality in their metal baskets or trays than they had when they used glass grilles. They said, "We have discarded glass grilles long ago. They are too expensive." And they made use of other excuses. But, however, we find in practice that we can get far better results from these glass grilles, because, as I have said, there is nothing to contaminate the ova or do them injury. The trout eggs absorb any metallic matter which may be in the water, and become so saturated with it in course of time as to be very seriously injured. They may not be absolutely killed at the time, but it has been found that, although there is only a slightly increased mortality in hatching upon the metal, there is a greater mortality amongst the fish afterwards. They do not live to grow up in the same way as they do when they are hatched on the glass.

RECENT CHEMICAL PROGRESS.

PROF. DEWAR lectured before the Royal Institution on April 16th, on Recent Chemical Progress. According to the report in the London *Times* Prof. Dewar dwelt especially on the great future opened out to synthetical chemistry by the employment of the temperature of the electric arc. Some of the most interesting results had been obtained from the electric furnace by the French chemist, M. Moissan, in the shape of carbides, stable bodies produced by the combination at high temperatures of carbon with various metals. Many of the carbides were decomposed by water, the hydrogen of the water combining with the carbon to form hydrocarbons. Thus with water some carbides, such as that of calcium, gave acetylene; others, like that of aluminium, gave marsh gas, while others again gave these and other gases, and what was most wonderful, liquid petroleums. It was a curions fact that many years ago Professor Mendeleef speculated that the only reason for the immense localization of petroleum at Baku was that it was being generated there by the action of water on carbides. His idea was rather smiled at then, but now it is his turn to smile. When acetylene was heated to a dull red heat it was polymerized to benzene. Benzene was the basis of all the new modern colors, and thus by three direct stages we were able to reach the nucleus of all the colors hitherto manufactured from coal-tar products. First there was the combination of lime and coke in the electric furnace; second, the decomposition of the carbide thus formed by water; and third, the transformation into benzene of the resulting acetylene by means of heat. Professor Dewar concluded by briefly discussing some of the properties of acetylene, explaining, among other things, the cause of its extraordinarily great luminosity as due to its peculiar endothermic structure.

THE MARINE BIOLOGICAL LABORATORY.

THE announcement of the Laboratory of Woodsholl for 1896 shows that several changes have been made. Prof. Bumpus has resigned the position of assistant director, which has been filled by the appointment of Prof. James I. Peck, of Williams College, who also has charge of the instruction in zoölogy. Dr. Setchell, owing to his removal to the University of California, has given up charge of the botanical department, which has been undertaken by Prof. Macfarlane, of the University of Pennsylvania. The officers having charge of original research in zoölogy include Profs. Howard Ayers, University of the State of Missouri; E. G. Conklin, University of Pennsylvania; W. A. Locy, Northwestern University; and M. M. Metcalf, the Woman's College of Baltimore. Prof. Whitman has charge of the work in embryology with the assistance of Dr. Lillie, of the University of Michigan, and Dr. Strong, of Columbia College.

The session of 1895 was unusually successful, the membership of the laboratory being 199, which was 65 in excess of the number in 1894, a regular increase having been maintained since the foundation of the laboratory in 1888. In 1895 there were 42 independent investigators at work and 21 carrying on research under supervision. In addition to the regular courses nineteen public lectures were given in 1895. The Marine Biological Laboratory is perhaps open to the criticism that the work is too much that of the laboratory and too little that of the naturalist, but this is only following the trend of biological science throughout the world. It is certain that nowhere else in America can biological research be undertaken with such pleasant and stimulating surroundings.

THE ZOÖLOGICAL SOCIETY OF LONDON.

ACCORDING to the London *Times*, the sixty-seventh anniversary meeting of the Society was held on April 29th. The report of the Council stated that the number of Fellows on January 1, 1896, was 3,027, showing a net increase of 55 members during the year. The number of new Fellows that joined the Society in 1895 was 197, which was the largest number of elections that had taken place in any year since 1877. The total receipts of the Society for 1895 amounted to £26,958 9s. 1d., showing an increase of £1,851 8s. 6d., as compared with the previous year. The ordinary expenditure in 1895 had amounted to £23,460 16s. 10d., being £155 6s. 9d. less than that of the previous year. Besides this a sum of £1,649 19s. 1d. had been charged to extraordinary expenditure. Of this sum £1,149 19s. 1d. had been devoted to the new scheme of drainage for the society's gardens, and £500 to the special acquisition of a giraffe for the menagerie. Besides this expenditure, £1,000 had been dovoted to paying off the last remaining portion of the mortgage debt on the Society's freehold premises, which were now valued at £25,000 and were absolutely free and unencumbered. A second sum of £1,000 had been transferred to a deposit account. After these payments a balance £1,391 1s. 2d. had been carried forward to the credit of the present year. A new edition of the list of animals in the Society's collection, of which the last (the 8th) was published in 1883, had been prepared under the direction of the Secretary. It would, it was hoped, be ready for issue before the close of the present year. A large number of accessions to the library were reported. The number of visitors to the gardens in 1895 had been 665,326, which was greater than it had been in any year during the past ten years. The number of animals in the Society's collection on December 31st last was 2,369, of which 768 were mammals, 1,267 birds and 334 reptiles. About 23 species of mammals, 22 of birds and one of reptiles had bred in the gardens during the summer of 1895. General the Hon. Sir. Percy Fielding, Prof. Alfred Newton, Sir Thomas Paine, Mr. E. Lort Phillips and Lord Walsingham were elected into the Council in the place of the retiring members. Sir William H. Fowler was reëlected President; Mr. Charles Drummond, Treasurer, and Mr. Philip Lutley Sclater, Secretary for the ensuing year.

GENERAL.

DR. N. L. BRITTON has been elected director of the New York Botanical Gardens and will resign the chair of botany in Columbia University, though he will probably remain connected with the University as professor emeritus. Prof. Lucien M. Underwood will be called to the chair of botany in Columbia University.

THE Smithsonian Institution has received from the State Department notification that the Fourth Congress of Criminal Anthropology is to be held at Geneva, Switzerland, under the auspices of the Swiss government, from August 24th to 29th of the present year. The government of Switzerland has, through its minister in Washington, invited the United States to send a representative to the Congress. Dr. Thomas Wilson, curator of the Department of Pre-historic Anthropology in the National Museum, has attended two of these Congresses, and prepared an elaborate report on the Second Congress, held at Paris in August, 1889. This was published in the Smithsonian report for 1890. It has not yet been decided whether or not the United States will send a delegate this year to Geneva.

AN effort is now under way in connection with the National Educational Association to bring about greater interest in the *teaching* of science than has hitherto been shown by American botanists, zoölogists, chemists, physicists, etc. The new Department of Natural Science Instruction is intended to bring together the teachers of the natural sciences who are interested in science *as a means of culture* and to stimulate thought and discussion as to how this end may best be obtained. What rôle should botany, zoölogy, chemistry, physics, etc., play in the mental development of man? In what way may the study of plants, animals, chemical compounds and physical forces be made an efficient factor in a man's mental training? When and how shall such study be made a part of a man's training? These are some of the questions which will be discussed in the Department of Natural Science Instruction in the Buffalo meeting of the National Educational Association on Thursday and Friday afternoons (July 9 and 10), led by Profs. Carhart (University of Michigan), Freer (University of Michigan), Coulter (University of Chicago), and President Jordan (Leland Stanford University). Prof. Charles E. Bessey, of the University of Nebraska, Lincoln, is President of the department, and Prof. Charles S. Palmer, of the University of Colorado, Boulder, is the Secretary.

THE Flower Astronomical Observatory of the University of Pennsylvania is now completed and preparations are being made for its dedication. Prof. Charles L. Doolittle now occupies the director's residence and with the instructor in astronomy, Mr. H. B. Evans, has commenced preliminary work. In addition to the Flower Observatory, it is proposed to erect a small working observatory on the University grounds in West Philadelphia. The building will be equipped with a transit instrument, zenith telescope and a 4-inch equatorial, which have been presented to the University by Mr. Horace Howard Furness, Jr.

THE University of Buda-Pesth in connection with its millenium celebration will confer the honorary degree of doctor of medicine on Dr. John S. Billings.

AT a recent meeting of the Board of Managers of the New York Botanical Garden, Judge Addison Brown submitted a report from the committee on plans which stated that plans for the museum building are being prepared by ten competing firms of New York architects. Two hundred and fifty-three persons, paying $10 a year each, have qualified for annual membership.

MR. T. D. A. COCKERELL, Las Cruces, New Mexico, proposes to found a biological station, and a beginning will be made this summer, if students can be found. There is in New Mexico a great abundance of new and interesting forms of life, especially among the insects, and many general problems, such as those of the life zones, can also be studied to great advantage.

THE Metric System, will be discussed by Herbert Spencer in a series of letters to appear in Appletons' *Popular Science Monthly* for June. Mr. Spencer opposes the further spread of the system, and points out the advantages of a duodecimal over a decimal system.

WE learn from the English papers that the following fifteen candidates have been recommended by the Council for election to the Royal Society: Sir George Sydenham Clarke, known for his publications on projectiles and fortifications; Dr. J. Norman Collie, Assistant Professor of Chemistry in University College, London; Arthur Matthew Weld Downing, Superintendent of the *Nautical Almanac;* Francis Elgar, Professor of Naval Architecture and Marine Engineering in the University of Glasgow; Andrew Gray, Professor of Physics in University College of North Wales; Dr. George Jennings Hinde, geologist and paleontologist; Henry Alexander Miers, known for his researches in mineralogy; Frederick Walker Mott, Lecturer in Physiology in Charing Cross Hospital; Dr. John Murray, editor of the *Challenger* publications; Karl Pearson, Professor of Mathematics and Mechanics at University College, London; Thomas Roscoe Rede Stebbing, known for his researches in natural history; Charles Stewart, Hunterian Professor of Human and Comparative Anatomy in the Royal College of Surgeons; William E. Wilson, astronomer; Horace Bolingbroke Woodward, of the Geological Survey of England and Wales, and William Palmer Wynne, Assistant Professor of Chemistry in the Royal College of Science, South Kensington.

THE first of the two annual *Converzationes* of the Royal Society was held on May 6th. The exhibits included X-ray photographs by Messrs. Swinton, Jackson and Sydney Rowland. Mr. F. E. Ives exhibited his method of color photography and Prof. Mendola gave a demonstration by means of the electric lantern of Prof. Lippmann's color photographs by the inferential method. Prof. Worthington showed photographs of the splashes produced by a falling drop of water taken with the electric spark, the exposure being less than three millionths of a second. A method was shown by which two or three thousand copies of a photograph can be printed, developed and fixed in an hour. The exhibits seem to have been largely in photography, but in addition Prof. Dewar repeated his experiments with liquid air, and the new binocular field glasses and stereo-telescopes of Mr. Carl Zeiss were exhibited.

AT the recent annual meeting of the members of the Royal Institution of Great Britain, the report of the committee stated that the property of the Institution now amounts to more than £100,000. 63 lectures and 19 evening discourses were given in 1895. The Duke of Norfolk was elected president for the ensuing year.

D. APPLETON & Co. will publish shortly, as a new volume in the International Scientific Series, *Ice Work, Present and Past*, by Dr. T. G. Bonney, professor in University College, London. It is said that in his work Prof. Bonney will give special prominence to those facts of glacial geology on which all inferences must be founded. After setting forth the facts shown in various regions, he will give the various interpretations which have been proposed, adding his comments and criticisms. He will also explain a method by which he believes we can approximate to the temperature at various places during the Glacial epoch, and the different explanations of this general refrigeration will be stated and briefly discussed.

IT is reported in the daily papers that in order to carry out still further certain recommendations of the recent committee on prisons, the directors of convict prisons in Great Britain have decided that, with a view to raise the moral tone and relieve the monotony of the life of convicts undergoing long sentences of penal servitude, lectures on scientific and interesting subjects shall be periodically given, and arrangements are in progress for giving early effect to this innovation.

IT is stated in the New York *Evening Post* that the British Government has determined to send two naturalists to Alaska to make a study of the causes of the mortality of the seals. Thirty thousand pups were found dead on the Pribylof Islands last year, due, it is said, to starvation following pelagic sealing. That the report of these naturalists may not be *ex parte*, and therefore inconclusive to the minds of the American people, it is desired that at least one thoroughly qualified American shall accompany them.

THE Astor Library will hereafter be open till 6 o'clock p. m. Electric light is being introduced into the library in order that the alcoves may be better lighted, and this will probably lead to the opening of the library in the evening. When the new consolidated library on Bryant Park Square has been built, it is intended to open the library on Sundays as well as in the evenings, and part of the books will be allowed to be taken from the building.

THE death is announced of Dr. Adelbert Krüger, director of the observatory at Kiel and editor of *Astronomische Nachrichten*. Krüger was born in 1832 and studied under and acted as assistant to Argelander, whose daughter he married. In 1862 Krüger was made director of the Observatory at Helsingfors; in 1875 he removed to Gotha and in 1879 succeeded Peters at Kiel.

THE annual field meeting of the National Geographic Society was held at Charlottesville, Virginia, on Saturday, May 16. The principal exercises of the day were held at Monticello, the home of Jefferson. This was followed by a visit to the University of Virginia and other points of interest in Charlottesville. According to the program an address of welcome was made by Mayor Patton, of Charlottesville, and responded to by President Hubbard. An address by Dr. Randolf, rector of the University of Virginia, was responded to by General A. W. Greely. Addresses were also made by Postmaster-General Wilson, on 'Jefferson at Home'; by Dr. McGee, on the 'Physiography of the Charlottesville Region'; by Dr. Goode, on 'Old Albemarle in the Revolutionary Period,' and by Prof. Thornton on 'Spottiswood's Journey Across the Blue Ridge.'

THE civil service examinations in New York and elsewhere are, it seems, often passed by proxy, and the Civil Service Commission following Mr. Francis Galton's recommendation, which they seem to have learned through a story of 'Mark Twain,' have resolved that, for the purpose of identification, candidates in examination for the position of fireman and policeman be required to make an imprint of their right and left thumbs upon paper.

MM. AUGUSTE GERARDIN and Maurice Nicloux report to the Paris Academy a method for measuring smells in the air due to organic vapors. By means of incandescent platinum they burn out the organic vapors and determine the decrease in volume. They have thus been able to find, for example, that the smell of violets occupies twice as much volume as the smell of camphor. They think the method can be employed to test the hygienic condition of the air of cities.

AT the annual business meeting of the National Geographic Society the following six members of the Board of Managers were elected for the next three years: Charles J. Bell, G. K. Gilbert, D. T. Day, W. H. Dall, H. G. Ogden and C. W. Dabney.

IT is announced that the Toronto meeting of the British Association in 1897 will be opened on August 18th.

IN a letter to the Secretary of the American Metrological Society, Mr. Horace Andrews, City Engineer of Albany, states that while a change to the metric system would probably occasion more awkardness in an engineer's office than anywhere else, yet he is in favor of change. He calls attention to the fact that in many old deeds and old maps the 'Ryland' foot and rod were used; this was probably a 'Rhineland' foot, its length being 1.0345 English feet.

IT is stated in New York *Evening Post* that Dr. William W. Jacques, an electrician of Boston, claims to have solved the problem of obtaining electrical energy from coal direct. As described by himself, in his application for a patent, he has discovered that "if oxygen, whether pure or diluted as in air, be caused to combine with carbon or carbonaceous materials, not directly, as in combustion, but through an intervening electrolyte, the potential energy of the carbon may be converted directly into electrical energy instead of into heat." His electrolyte is fused caustic soda, into which he places a stick of carbon, the oxygen being supplied by pumping in the air.

ACCORDING to *Nature*, a fine series of photographs of flying bullets, both in free air and in different stages of penetrating through a pane of glass, have been taken in Italy by Dr. Q. Majorana Calatabiano and Dr. A. Fontana, of the Italian Artillery. The apparatus described is a modification of that employed by Prof. C. V. Boys, and these photographs might, perhaps, more correctly be described as skiagraphs, since they are shadow-pictures produced on the photographic plate by the light from an electric spark produced by the discharge of a condenser. The chief peculiarity of the present figures is that, in addition to the anterior wave produced by the advance of the aërial disturbance, they exhibit dark striæ just in front of the projectile—a result not previously observed, and which the authors account for by supposing that the sudden compression of the air causes condensation of moisture producing an opaque cloud. In support of this theory, it is stated that the experiments were performed in a moist atmosphere. This blurred appearance is very similar to that which would be produced by the sparks arising from an oscillatory discharge of the condenser, but the careful precautions adopted by the experimenters to prevent any secondary discharge negative this explanation.

DR. CHARLES H. JUDD, who has recently been appointed instructor in psychology in Wesleyan University, is engaged in translating Prof. Wundt's recently issued Grundriss der Psychologie with the coöperation and under the direction of the author.

WE take the following items from the May number of *Natural Science*: "Dr. K. Lauterbach, Mr. Tappenbeck and Dr. Kirsting are leading an expedition to the Hinterland of New Guinea." "Dr. Nils Holst, the Swedish geologist, is to travel for a year in West Australia under the auspices of the Anglo-Scandinavian Exploration Company." "The 'Faraday' has returned from the Amazons, bringing with her Messrs. Austen and Pickard Cambridge, who have amassed a fine collection, chiefly of Arthropoda, and including several spiders' nests. These will go to the British Museum (Natural History). Some interesting bionomic observations have been made." "In connection with Andrée's balloon exhibition to the North Pole, it is hoped to send a zoölogical expedition, under the direction of G. Grönberg, lecturer at Stockholm University, to the Norsköar, near Spitzbergen, from which islands the ascent is to be made. These islands have long been known as one of the richest zoölogical localities in this region. A Polish contingent to the expedition is being planned by Dr. Roszkowski and Prince O. Hajdukievicz, who are both studying at Stockholm. If thirteen volunteers come forward, it is proposed to hire a steamer to accompany the 'Virgo,' which leaves Gothenburg with Andrée on May 1. After visiting Spitzbergen and the Norsk-öar, this steamer will return to the north of Norway to observe the solar eclipse."

AN editorial article in the London *Journal of Education* calls attention to the lack of psychological laboratories in England as compared with America, and emphasizes the fact by spelling 'psychological' 'pyschological' throughout.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. THOMAS MCKEAN has offered to give $100,000 to the University of Pennsylvania upon condition that $1,000,000 be collected. Mr. McKean, who is a trustee and an alumnus of the University, gave $50,000 about a year ago.

MR. CHARLES M. DALTON has given the Massachusetts Institute of Technology $5,000 for a scholarship in chemistry for graduate students. Preference will be given to those undertaking chemical research applicable to textile fabrics.

REAL estate and securities valued at $215,000 have been presented to the Northwestern University by William Deering, of Evanston, who had previously given the University about $200,000.

MR. AND MISS HOUGHTON, son and daughter of the late William S. Houghton, of Boston, trustee of Wellesley College, have given $100,000 for a chapel to be erected in memory of their father.

THE fourth summer meeting, conducted by the American Society for the Extension of University Teaching, will be held in the buildings of the University of Pennsylvania, Philadelphia, July 6–31, 1896. Botany, chemistry and psychology are especially well represented, five courses being offered in botany and four each in chemistry and in psychology. The lecturers include Dr. B. L. Robinson, Dr. John M. Macfarlane, Dr. J. W. Harshberger, Prof. W. P. Wilson, Prof. Byron D. Halsted, Dr. M. E. Pennington, Prof. William Freer, Prof. W. O. Atwater, Dr. F. G. Benedict and Prof. Lightner Witmer.

DISCUSSION AND CORRESPONDENCE.

THE SIGNIFICANCE OF ANOMALIES.

AT a recent meeting of the Boston Society of Natural History I remarked on the want of a satisfactory explanation of certain anomalies that it is the fashion to crudely class as reversions. I referred to the occasional appearance in man of some peculiarity of a lower form, which is in no conceivable line of human descent. I pointed out further that these anomalies were not only very numerous, but included features of the most diverse groups. To account for them by inheritance we must assume that they existed in a common ancestor of man and of the animal in which they are normal, with the astounding consequence that this primitive form, instead of being comparatively simple, must have been a perfect museum of anatomical curios, which is directly contrary to the principle of evolution. I failed to receive any information, and indeed did not expect any, for I have talked on this question with many, and have written and spoken publicly on it before. Testut's great work on muscular anomalies is a case in point; the author seems to be perfectly satisfied that he has accounted for a variation if he has shown it to be normal in some animal, no matter which. If I remember rightly, Gegenbaur, at the time, commented on this point, hinting that Testut's explanation needed to be explained. Within a few years the difficulty has been more frankly acknowledged. Thus in the Robert Boyle lecture delivered two years ago, Prof. Macalister said: "I cannot see that when one finds in the limb of a kangaroo or of a sloth, or in the face of a horse, a certain form of muscle like one which occurs as an anomaly in man, we must therefore conclude that its human occurrence must necessarily be due to atavism. Indeed the more I survey the catalogue of such parts the more I am impressed with the failure of the method as a scientific mode of accounting for these anomalies, while at the same time I am filled with admiration at the industry and ingenuity with which the process of matching has been carried on." Prof. George S. Huntington also recognizes the difficulty in his admirable paper on certain muscular variations in the Transactions of the New York Academy of Sciences. "I believe that we are right," he says, "in referring such variations * * * to the development of an inherent constructive type, abnormal for the species in question, but revealing its morphological significance and value by appearing as the normal condition of other vertebrates." But if so are we justified in calling them 'reversions?' Dr. Huntington's views do not seem to differ widely from those that I expressed in a paper on this subject in the *Naturalist*, of February, 1895. "Those very irregularities, which we call abnormal, point to a law in accordance with which very diverse animals have a tendency to develop according to a common plan." I do not need to be told that even to establish a law (and I have only hinted at one) is not in the least to show how it acts. All that I claim is that some other principle than atavism must be invoked. The pitiable abuse of it is shown in a book that I met the other day on the vermiform appendix. After stating that this is to be considered as the end of the cæcum, the author went on to remark that the rare cases of a double appendix, which are said to have occurred, are presumably to be explained by the double cæca found in many birds. Dr. Frank Baker, in the April number of the *Anthropologist*, severely criticises similar abuses.

The question is associated with another of very general importance, namely, whether similarity of structure is necessarily evidence of descent or even of relationship. One would think from certain writings that it is conclusive; but, of course, every anatomist knows that it is not. It seems that similar special organs, or arrangements of structures, occur in widely different orders in species of similar habits or surroundings. Mr. Dobson* instances a South American rodent with the habits of moles in which the arrangement of the muscles of the leg is the same as that of the true moles. This clearly points to a law which, it seems to me, the occurrence of anomalies tends to confirm. It is in the hope of having this discussed that I lay it before the readers of SCIENCE.

THOMAS DWIGHT.

*Jour. Anat. and Phys., Vol. XIX.

'PROGRESS IN AMERICAN ORNITHOLOGY. 1886-95.'

IN the *American Naturalist* for May (Vol. XXX., pp. 357–372) Dr. R. W. Shufeldt gives, under the above title, a statistical summary of the new American Ornithologists' Union 'Check-List of North American Birds,' with criticisms *passim* on various points, followed by an arraignment of the Committee which prepared it for ignoring all recent work on the classification of birds, there being no change in this respect from the 1886 edition. He proceeds to enumerate, for the benefit of this Committee and others, the various 'elaborate classifications of birds' and the various authors who have written on the taxonomy of birds, not omitting to mention, of course, those of Dr. Shufeldt. No doubt great advances have been made in the last ten years in the knowledge of the structure and relationships of various groups of birds; and while many moot questions remain, and authorities still differ respecting the propriety of many of the recently proposed changes, a few points may be considered as having been practically settled. While it might have been well enough for the Committee to have expressed its opinion on some of the questions thus raised, such a procedure, in view of the still very unsettled state of the subject, seemed not particularly called for; especially as there were practical difficulties in the way of introducing any change in the order or succession of the higher groups.

Dr. Shufeldt strangely overlooks the main purpose of the new Check List, which was not, as he seems to think, the incorporation of the various species and subspecies added during the last ten years, and the changes of nomenclature introduced during the same period, scattered through half a dozen supplements to the original list; while this was important, its main purpose was the revision of the matter relating to the geographical distribution of the species and subspecies, which the interval of ten years had rendered, in many instances, not merely imperfect, but absolutely erroneous and archaic. Yet this feature of the new edition seems to have escaped Dr. Shufeldt's notice, so greatly is he shocked by the lack of taxonomic revision.

In all Check Lists of North American Birds, from Baird's, published in 1858, down to Ridgway's and Coues' lists of 1880 and 1882, the species are numbered in an orderly sequence; and the numbers serve an important function, they being often used in the place of the names, not only in labeling specimens, particularly eggs, but extensively in correspondence between collectors, the number serving as a convenient symbol for the name. Hence it is important that they be given the greatest possible permanency. The A. O. U. Committee recognized this fact in preparing the Check List, and devised a scheme whereby any number of interpolations could be made without disturbing the notation of species already in the list. Of course, a transposition of groups would necessitate a new notation and create endless confusion and inconvenience, for which the Committee would receive condemnation compared with which Dr. Shufeldt's strictures can be easily borne, particularly since his views on several points are not extensively shared by other equally competent taxonomers.

The greater part of Dr. Shufeldt's paper consists of a detailed comparison of the two editions of the check list, with an analysis, taking the birds by ordinal or family groups, of the changes introduced in the 1895 edition. This is a useful statistical résumé for those interested in the subject.

It is, however, not free from typographical errors, nor from others that by no stretch of courtesy can be placed in that category. For example, *Megascops flammeola idahoensis* is recorded (p. 361) as *M. a*[*sio*]. *idahoensis;* the subgenus *Burrica* is mentioned (p. 365) as *Barrica;* it is said (p. 366), 'subgenus *Parus* inserted' in the 1895 edition, whereas it is given in the 1886 edition as well; on p. 368 the statement about the Swallow-tailed Gull is the exact reverse of the truth. His method of noting changes in the status of species or subspecies tends to a wrong conception of the facts in the case. Under 'species omitted' and 'species added,' etc., he places not only species omitted or added, as the case may be, but forms whose status has merely been changed from species to subspecies, or the reverse. Thus, as in the case of *Zonotrichia intermedia*, for example, where the change is from specific to subspecific rank, the change could have been easily and correctly indicated by a formula like the following: *Zonotrichia intermedia* (1886) = *Z. leucophrys intermedia* (1895). In place of this *Z. intermedia* is placed under 'species omitted' and *Z. leucophrys intermedia* in the list of 'subspecies added;' whereas, so far as the number of forms is concerned, there is neither omission nor addition.

In a footnote to p. 364 we find the following: "The Starling (*Sturnus vulgaris*) essentially gained a place and recognition in the A. O. U. 'List' from the fact that it has been successfully 'introduced' from abroad. If this be granted, the Committee were guilty of very unscientific practice when they omitted the English Sparrow (*Passer domesticus*) from the 'List' (also *Passer montanus*), and it can only stand as an example of how far men will allow their prejudices to carry them and blind their scientific instincts." If the critic of the A. O. U. Committee had taken the trouble to refer to the 1886 edition he would have found that the Starling was introduced in the first edition of the 'Check List' on the basis of its occurrence in Greenland, and that his presumptuous criticism and moralizing about 'prejudices' were wholly without cause. Since the publication of the first edition the species has been 'introduced, by importation in numbers from Europe, and appears to have obtained a permanent foothold here—a fact it seemed worth while to mention in the second edition of the 'Check List.' No 'introduced' species has been introduced in the Check List, which is intended to be what its name purports—a list of North American birds. Of late years many species of foreign birds have been 'turned out' in various parts of the United States and Canada, but with what results it is impossible as yet to determine. Dr. Shufeldt will find, however, in the 'Abridged Edition' of the 'Check List,' published in 1889, a list of 'Introduced Species," ten in number, which at that time were known to breed in this country in a wild state. But this list forms no part of the Check List proper.

The above reference to the Starling in Dr. Shufeldt's paper, taken with other passages in the same article, clearly reveals the animus of his critique.

J. A. ALLEN.

'WHAT IS TRUTH?'

In all our speculations concerning nature what we have to consider is the general rule. For that is natural which holds good.

Aristotle, Parts of Animals III., II., 16.

Knowledge is a double of that which is.

Mr. Bacon in Praise of Knowledge.

Nature means neither more nor less than that which is.

Huxley, VII., p. 154.

If the author of the letter on 'The Material and the Efficient Causes of Evolution' (SCIENCE, p. 668), will refer to an article which the Editor asked me to give him, and printed in SCIENCE in February, 1895 (Vol. I., No 5, p. 125), I think he must admit that I, at least, have not committed the blunder which he lays to the charge of certain unspecified 'Neo-Darwinians' and 'Neo-Lamarckians,' and that there is no just *cause or reason* why my name should be dragged into print in this connection.

However, I heartily agree with him that rigorous exactness is necessary in the use of philosophical language; and I also agree with him that, when no qualification is used, or implied, the English word *cause* should mean 'that which produces a thing and makes it what it is;' although it is one thing to define a word and quite another thing to show the existence of any corresponding reality.

As I am advised by this writer to consider Aristotle and be wise, I refer the reader to the passage I have put at the top of this letter, for it shows that this great naturalist is in accord with Bacon and Huxley in the opinion that our business in this world is to learn all we can of the *order* of nature, leaving to more lofty minds the attempt to find out what it is that 'produces a thing and makes it what it is,' and every other 'necessary condition of truth' except evidence.

This correspondent says the word conceive is not used with precision in my assertion that, evidence seeming adequate, I believe things which I cannot conceive. As Huxley has never been accused of inexactness in the use of words I call attention to the following passages which show that this cautious thinker also believed what he could not conceive.

"I *cannot conceive* how the phenomena of consciousness are to be brought within the bounds of physical science," IX., III., 122.

"I *believe* that we shall, sooner or later, arrive at a mechanical equivalent of consciousness, just as we have arrived at a mechanical equivalent of heat," I., VI., 191.

W. K. BROOKS.

MAY 4th, 1896.

THREE SUBCUTANEOUS GLANDULAR AREAS OF BLARINA BREVICAUDA.

TO THE EDITOR OF SCIENCE: Though the subcutaneous glands in *Soricidæ* have received much attention, these structures are not so well known in all details that further observations on the subject can be considered superfluous.

In examining perfectly fresh individuals of the common short-tailed shrew, *Blarina brevicauda*, taken in midwinter, when glandular development or activity is presumably less evident than it becomes during the rut, I find three large glandular areas—a lateral pair and one inferomedian.

On each side of the body, midway between the fore and hind limbs, may easily be recognized a glandular area, half an inch long and one-half as wide, in part overlying the posterior border of the thorax, and thence extending over the abdomen. This is observable without dissection; for, on blowing aside the long hairs which cover it, the space appears to be naked, though it is in fact clothed with short adpressed colorless pelage, like that on the dorsum of the manus. Small flakes of the inspissated secretion may be noticed; but the glandular orifices are too minute to be made out, even with a hand lens, though these may become more readily discernible at another season. Nor is any musky odor perceptible in the present specimens.

The third glandular area of this shrew is larger than the lateral ones, and this is the fact to which I may direct particular attention. This additional patch is situated on the median line of the belly, opposite the lateral tracts, and extends three-fourths of an inch caudad from the end of the sternum. In outward aspect this tract is identical with the others. On raising the skin the glandular structure is very evident; it is the same in appearance, under the lens, as that of the lateral tracts, but thicker as well as more extensive.

All three tracts are strictly subcutaneous, and come away from the subjacent parts when the skin is raised. They are supplied by large cutaneous vessels, the ramifications of which are conspicuous beneath the integument. This vascularity reddens the minutely granular texture of the glands, which a low magnifying power discloses. The three areas appear alike in both sexes.
ELLIOTT COUES.

WASHINGTON, D. C., May 7, 1896.

INSTINCT.

EDITOR SCIENCE: It seems to me that it would be well to keep the issue with which this discussion started in view, and then the direction in which the truth lies will be clearer. Nothing could be more explicit that the statement by 'The Writer of the Note' in SCIENCE of February 14th, which was this: "A chick will peck instinctively, but must be taught to drink. Chicks have learned to drink for countless generations, but the acquired action has not become instinctive."

In other words, the view that eating is instinctive and drinking is not, was that taught by Prof. Morgan and endorsed by 'The Writer of the Note' in a subsequent communication. Feeling that an important truth was being imperilled, I advanced facts to show that such a view was untenable. This was followed by the recital of additional facts by others, so that it was plain to myself—more so than ever—that such a theory as that first advanced was not sound. I was aware that all three of the writers supporting this view were in accord, constituting a sort of trinity in unity; there was, nevertheless, a great lack of harmony which seemed to be owing to the somewhat important defect that their views were not endorsed by Nature.

Now, to my surprise, Prof. Baldwin claims that I have missed the real point which he takes to be that an instinct may be only 'half congenital,' and cites this drinking of chicks; but according to the above quotation drinking is not instinctive at all, so that it looks as if the shoe was on the other foot.

In 1894, in a paper read before the Roy. Soc. Can. on 'The Psychic Development of Young Animals,' published in the Proceedings of the Society for 1895 and a copy of which was forwarded to Prof. Baldwin, I emphasized the conception that instinctive acts are *never perfect* at first, or, as Prof. Baldwin would prefer to say, are only partially congenital, though whether such an expression as 'half congenital' is a valuable addition to the English language, I doubt. Now it would be strange that I should alter my own views without noting the change, and miss the point in a matter which I was, I think, the first to emphasize; in fact, I have in this very correspondence in SCIENCE urged this view—the imperfection of instincts. If Prof. Baldwin and those he professes to interpret will grant that eating and drinking in chicks are instinctive; that both alike are imperfect at birth; that congenitally the chick is in the same condition to all intents and purposes as regards eating and drinking, he will, I believe, be in accord with the facts, and we shall all agree that the much overlooked imperfection of instincts is well illustrated by the subjects under discussion, but I should like to add, universal in its application, though in varying degree, the imperfection being in some cases not very obvious to our inadequate observation.

But in discussing evolution I feel that we are on a different plane. Here the appeal to facts is of a much less decisive character.

I have been trying since reading Prof. Baldwin's letter in SCIENCE of May 1st, in reply to my own, to ascertain his real views in regard to evolution, and have some hesitation in deciding whether I really grasp his meaning or not. However a few concrete cases may make matters plainer. A and B are, let us suppose, two individuals that survive because they can and do adapt to the environment; X and Y die because they cannot; or in Prof. Baldwin's terminology, A and B adapt to their 'Social Heredity' constituting 'organic selection' which is ontogenetic or affects the individual. But the survival of individuals specially adapted affects the race or phylum. But surely an individual adapts to an environment ('social heredity') because of what he is congenitally. In the language of evolutionists this is survival of the fittest or natural selection, though Prof. Baldwin seems to think he has introduced a new factor in his 'social heredity.' The name is new and to my mind objectionable, as there is no real heredity; the idea is not.

Ordinary people express themselves by saying that we become what we are because of 'education,' 'circumstances,' etc. We say, "The man is the product of his age."

People tend to believe too much in the power of education, circumstances, etc., and too little in heredity; hence all sorts of cures for deep-rooted evils are ever welcome. But we find that the changes wrought by 'social heredity' are very much on the surface, and in consequence there may be but little outcome from these effects, possibly none in some cases, in heredity, as ordinarily understood, which does not, however, contravene the Lamarckian or any other well recognized principle of heredity or evolution. To return to the concrete: A and B have offspring, differing slightly from themselves. The 'social heredity' has had little effect, therefore, on the race; in the case of the lower animals, much less than in the case of man, possibly, and if the offspring C and D be placed in widely different environments the slight extent to which they have varied (congenitally) will be all the more evident.

A Lamarckian explains these variations, such as they may be, by the influence of the use and disuse of parts, and evolutionists of other schools in other ways. Prof. Baldwin misapprehends, I take it, the sense in which I employed the term 'use' in the phrase which he quotes from my last letter. The Lamarckian sense was that intended.

I must repeat that, after reading a good deal of what Prof. Baldwin has written on this aspect of evolution, it still seems to me that while he has with new terminology set forth old views in a new dress that there is really no new principle or factor involved. I do not, of course, consider such writing without special value, though it may sometimes be provokingly difficult to understand from the new technicalities employed, for the relative parts played by heredity and environment in the make-up of each individual is an interesting and practically very important problem.

If I have failed to understand Prof. Baldwin fully and so to appreciate his views at their full value on the score of originality, I regret it. However, it is likely that others are in the same case, and I venture to suggest that the remedy for our denseness, if such it be, is to be found in a specific and concrete treatment of the subject.

WESLEY MILLS.
McGILL UNIVERSITY, MONTREAL.

NOTES ON PERCEPTION OF DISTANCE.

IT appears to me that the best *data* for determining the psychological elements in the perception of distance, as I suggested some time since in SCIENCE *apropos* of mountain climbers, is to be derived from those men of mature and reflective mind who, finding themselves in very strange surroundings, are compelled to learn a new language of distance. From them we can obtain direct evidence of what passed in their consciousness, an evidence thus far superior in value to the indirect judging from the action of infants or young animals, or even the meager and few reports of the blind who have suddenly received sight. Even supposing a blind genius for psychological analysis to be suddenly given sight, the fact that an absolutely novel and complex experience was produced which included much else than mere perception of distance, as light, color, form, would tend to make his evidence to some extent unsatisfactory. For the best results in the study of perception of distance we must then find it in course of formation with individuals sufficiently educated and reflective to give some account of their experience. Even then the forming perception may be so instinctive a process that the elements may not be clearly discernible. For instance, Mr. Casper Whitney in the strange surroundings of the Barren Grounds had to learn a new form of distance which he thus describes in *Harper's Magazine* for April, 1896, (p. 724): "I began my first lessons in Barren Ground distance-gauging by guessing the yards to a stone and then pacing them off. I was not only astonished at the discrepancy between my guess and the actual distance, but oftentimes by the size of the rock when I reached it. A stone which looked as large as a cabin at four or five hundred yards would turn out to be about as big as a bushel basket. I found much difficulty in overcoming the tendency to exaggerate distance, though the Indians apparently were not so troubled." In response to my inquiry, he further writes: "When I got so I could judge the distance with comparative accuracy, it was simply that I had to accommodate myself to the new (to me) size of rocks at those distances." From which it is plain that the newly determined distance by pacing did not alter the apparent size of rock, the apparent size is simply interpreted for a new distance value. He says to himself, "that appearance means not as I might before have judged, but so much more or less distance." In other words there is here no judging from sense of accommodation or muscular sense of any kind, because that is unaltered, the image of the thing seen being constant as to size and appearance. Distance for Mr. Whitney seems to be purely a judgment, more or less revised by actual pacings, of fixed visual appearances.

Another point on the perception of distance was suggested by James (Psychology, II., 213): "I cannot help thinking that anyone who can explain the exaggeration of the depth sensation in this case (inverted vision) will at the same time throw much light on its normal constitution." This suggests whether bats which habitually hang head downwards would not have distance lengthened by erect vision. I do not know whether this could be tested by bringing certain foods to the attention of such animals at varying distances for inverted and erect vision. I found by some simple experiments upon myself and also upon a friend that lying down, with the head in horizontal position, distance was shortened, but I was not able to test at what angle toward inverted vision distance first began to lengthen. If not already tried, it might be useful for some of our psychological laboratories to set up a tackle, so that a person might be revolved through the whole circle, and the effect on perception of distance noted at all angles. It would also be well to test whether inverting the object looked at disturbed the sense of distance. I got no result in this matter by looking at objects at the end of a long hall. HIRAM M. STANLEY.

LAKE FOREST, ILL., April 27.

THE MAMMOTH BED AT MOREA, PA.

TO THE EDITOR OF SCIENCE: The following interesting section was found on the glaciated outcrop of the Mammoth (E) bed at Morea, Pa., within one mile of the farthest southern limit of glaciation, and from 20 to 25 miles south of the moraine of Lewis and Wright. The measures are nearly vertical and form a narrow and deep basin. A section taken on the bed gave:

(a) Till of sandy, clayey nature, with burden of Pottsville conglomerate and varying sandstones, and with irregular lenticular patches of clean reddish clay of small extent. The solid burden is angular and sub-angular, and not polished nor striated. In some cases boulders 5 feet thick occur. Total thickness, 6 to 10 feet.

(b) Crushed anthracite, bright and firm, shipped to market. This is readily scraped up with the fingers. In places to the north hundreds of tons of this crushed coal have been sold. When we realize that this is under a sandy till we can estimate the comparative recency of glaciation. In some places this layer will reach 18 inches in thickness.

(c) Rotten anthracite with angular specks of firm slate from coal. Thickness $\frac{3}{4}$ inches.

(d) Sandy clay, usually grayish, but sometimes clear red or yellow. It bears rolled and angular quartz and slate pebbles, pieces of anthracite, but little anthracite dust. Thickness 1 inch.

(e) Crushed anthracite, firm and bright, like (b). Thickness $\frac{1}{4}$ to $\frac{3}{4}$ inches.

(f) The glaciated surface of the outcrop of the bed. Soft and fully rotted so as to be dull, like black chalk, and easily cut by the finger-nail. Thickness $\frac{3}{5}$ of an inch.

(g) Solid and bright anthracite of the bed.

On comparing unglaciated or protected outcrops we find (f) measuring many feet in depth. We find here that the amount of decomposition of solid coal since glaciation is $\frac{3}{5}$ of an inch.

The presence of the layer (d) is peculiar between two layers of crushed anthracite which are bright and fresh.

The solid state of the coal is analogous to the similar state of the slate in the small quarry near Siegfried, where workable slate is quarried immediately under glacial gravel. Both are on the line of farthest ice extension—of earliest extension—and speak of its recency.

EDWARD H. WILLIAMS, JR.

LEHIGH UNIVERSITY,
May 11, 1896.

A METEOR.

TO THE EDITOR OF SCIENCE: A few days ago I observed a meteor of such size as apparently to merit record. At 7:30 p. m. of May 9th the object was first seen in the twilight descending in a straight course toward the northwest at an angle of about 20° with the plane of the horizon, moving rather slowly and shining brilliantly with a greenish light. It very soon after burst into numerous fragments, the position at rupture bearing about 30° west of south from the end of the Norfolk and Washington steamboat pier at Alexandria, Va., and being at an elevation of about 10° above the horizon.

THOS. L. CASEY.

X-RAY PHOTOGRAPHY BY MEANS OF THE CAMERA.

I HAVE recently succeeded in producing X-ray pictures, reducing them in their linear dimensions to one-fifth the size of the object. The method used was to produce on a tungstate of calcium screen the shadows of the object, the screen with its contents being then photographed by means of the camera in the ordinary way.

The photographs thus obtained reveal the details more clearly than the eye can see them on the screen, and, in fact, reveal details not visible to the eye.

There is some advantage in this method over that usually employed. The photographic plates may be made of reasonable size for large objects. The pictures gain somewhat in definition, as penumbral effects are reduced. The disadvantages are the difficulty of accurately focussing the faint images on the ground glass of the camera, and the longer time of exposure needed to bring out the picture. I think it probable that these difficulties may not be very serious to those possessing the best facilities for making further study in this direction.

FRANCIS E. NIPHER.

WASHINGTON UNIVERSITY,
ST. LOUIS, May 11, 1896.

THE ROTATING CATHODE.

SINCE writing an account of my observation on the rotation of the cathode disc (p. 750) it has occurred to me that a circular or elliptical vibration of the cathode wire might possibly account for the observed effect. The tube on which the observation was made has been cracked, and now ceases to give the result, nor am I able to impart rotation in one direction only to the disc by familiar mechanical means that could have existed in the tube. The observation is one of such great interest that I think I should suggest the above possible explanation, which had not sooner occurred to me, in order to prevent experimenters from going on what may be a wild-goose chase. FRANCIS E. NIPHER.

MAY 13.

SCIENTIFIC LITERATURE.

The Principles of Museum Administration. By G. BROWN GOODE, LL. D. (Reprinted from the Annual Report of the Museum Association, 1895.) York, 1895. Pp. 73.

"The degree of civilization to which any nation, city, or province has attained, is best shown by the character of its public museums and the liberality with which they are maintained." The above sentence—the concluding sentence of the paper before us—sets forth in striking phrase the importance of the subject with which the paper deals. Superlatives are in general things which a cautious man views with suspicion, and it may well be doubted whether any one index of the state of civilization can be said to be the best. But that museums afford one of the most trustworthy indices of the progress of civilization cannot be doubted. The indication which they afford is decidedly flattering to our generation; for this is certainly preëminently the age of museums. In the number of museums, large and small, general and special, in the munificence with which they are sustained and endowed, in the knowledge, taste and skill displayed in their housing and installation, the latter half, and especially the last quarter, of our century marks a prodigious advance.

It is rather remarkable that, while so much of thought and labor has been expended upon museums, and so much has been written upon various special questions connected with their administration, hitherto no attempt has been made to give a compact, systematic and comprehensive formulation of the principles of museum administration. That desideratum is admirably supplied by Dr. Goode's little treatise. No more competent hand could have essayed the task. Graduated from Wesleyan University a quarter of a century ago, Dr. Goode served an apprenticeship of a few years in the administration of the little museum of that institution, and displayed from the beginning the scientific and administrative ability which was soon to find an adequate field in the National Museum. To his genius is largely due the rapid advance in methods of installation, labeling and general administration, which has given the United States National Museum a rank among the foremost, not only in the wealth of its material, but also in the excellence of its arrangement. In the study of museum administration, Dr. Goode has made himself familiar with most of the great museums of the world, and with many of the most important of the great expositions of the last quarter-century. On this subject, therefore, he speaks 'as one having authority.'

Within the compass of about three score and ten pages he has formulated the general principles of the relation of the museum to other institutions and to the community, the classification of museums, the preservation, preparation, installation, labeling and use of the materials of which the museum is the custodian. These principles are often stated in the sententious form of aphorisms, many of which deserve to become maxims for the guidance of museum workers. The author finds room, however, to illustrate the subject by brief but exceedingly interesting notes on many of the leading museums.

The sections of the paper treating of the general relations and classification of museums have been published in Science, August 23, 1895, and January 31, 1896. It is therefore superfluous to give any criticism on those portions of the work. The more technical parts of the work, referring to the treatment of specimens, labeling, and installation in general, are of special interest to museum workers.

In the section on specimens, emphasis is placed on the idea of the limitation of every museum to a definite plan and scope. The authorities of a museum, instead of collecting with a dragnet all objects that may be of interest to anyone, should decline to receive specimens or collections of specimens not germane to their plan. In the interest of this limitation and specialization, the policy is advocated of extensive transfers of material from one museum to another by exchange or gift. The doctrine is undoubtedly a sound one, though it is easy to see that, in the case of small museums with limited endowments, dependent for their maintenance and progress on the good will of various benefactors, the doctrine cannot be rigorously put in practice. In the same spirit it is urged that not all the specimens belonging to any museum should be exhibited. The exhibition series especially should be made to conform to a definite plan. The series should be symmetrical, and superfluities should be rigorously excluded. This rule, unquestionably sound in principle, will naturally be subject to some modification in practice. The distinction in purpose and in administration between the exhibition series and the study series is admirably formulated.

The subject of labels is treated very fully and satisfactorily. Emphasis is placed on the value, in the exhibition series, of somewhat elaborate descriptive labels—a means of popular instruction which is admirably exemplified in the National Museum.

We are tempted to copy a few of the pithy aphorisms in which the paper abounds.

"A finished museum is a dead museum."

"It is the duty of every museum to be preeminent in at least one specialty."

"A museum officer or employé should never be the possessor of a private collection."

"An efficient educational museum may be described as a collection of instructive labels, each illustrated by a well-selected specimen."

"To complete a series, any specimen is better than none."

"A copy, model or picture of a good thing is often more useful than an actual specimen of a poor one."

"Restorations made in such a manner that the part restored is not at once distinguishable are unpardonable."

"A label (in the exhibition series) should answer all the questions which are likely to arise in the minds of the persons examining the object to which it is attached."

Dr. Goode's critical notes on various museums, introduced as illustrations of the principles discussed, are so interesting as to suggest that the author would render the scientific public a further service, if he could find time to expand this little pamphlet into a moderate-sized treatise on the museums of the world and their administration.

WM. NORTH RICE.

Spectrum Analysis. DR. JOHN LANDAUER. Brunswick, Fred. Vieweg & Sohn. 1896.

This handbook of some 175 pages is substantially a reprint of the author's article upon Spectrum Analysis, which appeared in the 'Handbook of Chemistry' of Drs. Fehling and Hell. Though now somewhat enlarged, it still treats more particuiarly of the chemical applications of the subject. A brief historical introduction, covering the time from Melville to the present day, is followed by tolerably complete descriptions of instruments for obtaining and examining the various spectra. No attempt is made to develop the theory of any of the instruments considered. The conditions affecting the character of emission and absorption spectra, and the empirical formulæ which have been suggested to express the relation between the lines and groups in the spectra of different elements are also touched upon, and then follow tables of wave-lengths of various metalic spectra. These embody the recent work of Kayser & Runge, Rowland and others, and all wave-lengths are expressed in Rowland's scale. Rowland's (1892) table of solar wave-lengths is also given, and the principal astronomical applications of spectroscopy are briefly treated in some fifteen pages at their end. Throughout the book copious references are given to original papers, etc., the whole forming a fairly complete resumé. The English student will find the German unusually clear and concise.

C. E. M.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, APRIL–MAY.

The Magmatic Alteration of Hornblende and Biotite: By HENRY S. WASHINGTON.

It is well known to petrographers that these minerals, under some conditions, tend to alter into a granular mass of augite and magnetite. The causes of this alteration are here discussed. After reviewing current theories, including that of Zirkel, the author proceeds to develop his own views. He finds that this alteration is most common in the intermediate group of volcanic rocks. He also finds it rare in the plutonic rocks. From the latter fact he infers that conditions of slight pressure are favorable to the changes. The theory proposed is that hornblende and biotite crystals are formed at an early (intratelluric) stage of eruption under conditions of great pressure, and probably in presence of mineralizers. As they approach the surface in the course of an eruption the pressure diminishes, leaving the temperature still high until a point is reached where the substance is no longer stable. Here a molecular change is begun which induces a molar change, so that the chemically and physically homogeneous hornblende or biotite becomes the heterogeneous granular aggregate of augite and magnetite. The origin of the augite andesites is then discussed in the light of this theory.

On the Origin of the Chouteau Fauna: BY HENRY SHALER WILLIAMS.

In a former number of the *Journal of Geology* the origin of this fauna was discussed by Stuart Weller. In the present paper the author dissents from two opinions therein expressed (1) that the Chouteau fauna was contemporaneous with the Chemung fauna of New York, and (2) that it arose by the mingling of a fauna which in the Devonian was represented by the Hamilton in New York and the general Devonian fauna of Europe represented by the Middle Devonian of Iowa and British America. Three reasons are given (based on the study of the faunas themselves) for thinking the Chouteau was later than the Chemung. From a similar study, the author concludes that there is not at hand sufficient evidence of the composite origin of the fauna in question.

North American Graptolites: By R. R. GURLEY.

The present paper is a continuation of one in the January-February number of the *Journal.* The vertical range of graptolites is quite fully discussed and tables are given showing the horizon and geological range of each species so far as the facts are known. The value of these tables is much enhanced by references to the original sources of information in a large number of cases. The author finds that graptolites may be clearly traced to the beginning of the Carboniferous period, and he thinks it likely that allied genera lived through the Paleozoic.

Deformation of Rocks, II., An Analysis of Folds: By C. R. VAN HISE.

Folds are divided into simple, composite and complex. The author compares a rock fold to a wave of the sea, each large wave having superposed on it waves of the second order, these having waves of the third order, etc. Thus while the forces producing them are different, the complexity of the two are comparable. Various forms of folds are figured, and the relation between them clearly stated. Simple folds may be united to produce a great variety of composite structures, anticlinoria and synclinoria. These may be normal or abnormal and upright, inclined or overturned. As to abnormal composite folds, several factors modify the result. (1) Readjustment between the beds; (2) the great strength of the older rocks; (3) decreasing lateral stress with depth; (4) the position of the fold in the group of rocks folded. Complex folds are folds considered in three dimensions. This complexity may be due to differences in thickness and strength of beds in different places, unequal thrust on different parts of the border of an area, and to the fact that thrust may be in two or more directions. A number of practical directions are given for discovering and interpreting in the field the structure of complex folds.

C. R. Van Hise continues the 'Summary of Current Pre-Cambrian North American Literature.' S. Weller contributes a review of Williams' 'Geological Biology.' A long list of the publications recently received closes the number.

D. P. N.

SOCIETIES AND ACADEMIES.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, APRIL 28, 1896.

(1) *April recess excursion to the Middle Susquehanna, Pa:* By W. M. DAVIS.

The special object of this excursion was to study on the ground the deflected tributaries of the Susquehanna in Union and Snyder counties, Pa., and to determine their bearing on the hypothesis that the Susquehanna was superposed by flood plaining on the two synclines of Pocono sandstone in Dauphin county at a late stage in the Cretaceous cycle of denudation. (See Rivers and Valleys of Penna., Nat. Geogr. Mag., I, 1889, 241.) Spruce run and Buffalo creek, Penn's creek and Middle creek were examined; Penn's creek being the most significent, as it abandons a well-defined limestone and shale valley and turns south through ridges that surmount by a moderate measure the Tertiary peneplain of the region. These various streams cannot be regarded as antecedent to the time of mountain folding, for they are systematically placed with respect to the Susquehanna; they cannot be regarded as adjusted to the structures of the region, for they stand in most diverse relation to resistant and weak strata and to anticlines and synclines; their systematic southward deflection suggests the influence of an ancient flood plain of the Susquehanna that was formed on a peneplain of the past, of just the same kind as the influence exerted by the growing flood plain of to-day at Selin's Grove, where Penn's creek, after approaching within half a mile of the main river, has to flow four miles southward along the inner border of the plain before mouthing. Admitting that the deflection of the several streams was caused by flood plaining, this is shown to have been ancient, not only by the relation of Penn's creek to the low ridges that surmount the dissected Tertiary peneplain, but also by the imminent readjustment of some of the deflected streams by longitudinal subsequent streams that are growing along weak strata from the main river; thus Penn's creek is almost captured by a longitudinal subsequent stream that enters the Susquehanna at Winfield; North Mahantango creek is likewise nearly diverted by a longitudinal subsequent branch of Middle creek that flows by Freeburg; and perhaps the direct longitudinal course of White Deer creek, further north, may be explained as a return to its normal attitude; its former southward deflection being suggested by the occurrence of a large number of Medina boulders on the col by which it is now divided from a south-flowing, transverse branch of Buffalo creek.

Among numerous points of interest noted during the trip may be mentioned: The superb view of the Delaware watergap, deep cut in level-crested Kittatinny mountain, as seen from the edge of Pocono plateau; the monotonous surface of this plateau, over 2,000 feet above tide, nearly stripped of its timber, almost uninhabited, and yielding little more than the winter ice crop of its numerous ponds; the alluvial fans, locally known as 'bulges,' formed on the low valley floors beneath various notches in the Medina ridges of the Seven mountains, one fan at Glen Iron having a radius of half a mile and a height of about three hundred feet, now somewhat trenched by its stream; the Pocono synclinal coves west of the Susquehanna, opposite Millersburg and Dauphin; the long straight boulder-strewn valley floor of Stony creek, east of the Susquehanna between Second and Third mountain, the boulders having crept down from the crests of Pocono and Pottsville sandstone and conglomerate, producing an irredeemable veneer over the otherwise fertile Mauch Chunk red shales; and the immediate transition from this uninhabitable valley to fertile fields on passing through Fishing creek gap to the more open country between First (Blue) and Second mountain.

(2) *April recess excursion to Gay Head, Martha's Vineyard:* By J. B. WOODWARD.

T. A. JAGGAR, JR.,
Recording Secretary.

NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Section of Astronomy and Physics on May 4th Prof. A. M. Mayer presented a paper on a heliostat with small mirrors, giving an intense beam of light and forming an image at its focus. It consists in mounting a convex lens so as to concentrate the beam of sunlight upon one surface of a total reflection prism, the lens being mounted to rotate upon a polar axis so as to keep the sunbeam continually upon the mirror. A negative lens near the prism renders the beam parallel again. A second total reflection prism sends the beam in any desired direction. The advantages of this heliostat are a very powerful beam of light which can be made to emanate practically from a point, and from which the heat rays have been almost entirely absorbed by its passage through the various pieces of glass. It is especially adapted to work with the solar microscope and experiments on the interference of light. The paper was discussed by Prof. R. S. Woodward.

The following notes were presented by Mr. Wallace Goold Levison. (1) On photographs of Geissler and Crookes' radiant matter tubes.

Mr. Levison presented a very interesting series of photographs of Geissler and Crookes' tubes taken by their own light. Many of these showed very beautifully the stratification in the Geissler tubes and the difference between the phenomena at the anode and at the cathode. He also showed a series illustrating the disturbances in the stratification produced by plunging the cathode to various depths in water. The photographs of the Crookes' tubes showed not only the fluorescent spot opposite the cathode, but also very distinctly the pale bundle of cathode rays which are almost invisible to the unaided eye. (2) In this connection Mr. Levison pointed out the resemblance between the succession of colors with varying pressure in Geissler tubes and the color variation in the aurora, and suggested that the experiments described bore out the idea that the aurora is an electric discharge through the atmosphere at various heights and pressures. A possible connection between these phenomena and the solar corona and comets was also pointed out.

The third note was the description of simple apparatus for obtaining X-ray photographs by long exposure with small (6-inch) induction coil and four Bunsen cells. The fourth note was descriptive of certain plates which were exhibited appearing to indicate a magnetic action on photographic plates. These are called magnetographs and were made by placing various objects directly on the photographic film and suspending a magnet in front of them. No satisfactory explanation or theory of the results has been given. Fifth note: In conclusion, Mr. Leviston pointed out certain causes which, in his opinion, might account for the deterioration of photographic plates, suggesting among other things X-rays from unexpected sources, terrestrial magnetism, plant or fungus organisms, and gases, such as sulphuretted hydrogen, penetrating the boxes and injuring the plates. He suggested that the test should be made by enclosing the plates in soldered metal boxes. These notes were discussed by Profs. Mayer, Hallock, Van Nardroff, and others.

By permission of the Section Mr. C. C. Trowbridge read a paper entitled 'The Use of the Hair Hygrometer,' which will be published in this JOURNAL.

W. HALLOCK,
Secretary of Section.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, APRIL 14.

IN connection with the presentation of a collection of recent and fossil Strombidæ Mr. H. A. Pilsbry discussed the ancestry of Strombus Costata and Melongena subcoronata, their relations, fossil species being illustrated by large suites of intermediate forms.

Mr. Jos. Willcox commented on the influence of environment on the species as illustrated by specimens presented. It was apparent that those from the southern coasts of Florida swept by the Gulf Stream were all of a dwarfed type.

Mr. Benj. Sharp related the plentiful occurrence of a tetenophore, Mneopsis Ludyi in a fresh water pond near Nantucket. The embryos had been swept in by an accession of salt water and had accustomed themselves to their new environment. The species did not, however, persist in the pond in consequence probably of the severity of the winter. Specimens of the species referred to were beautifully preserved in a two per cent. solution of formaline.

Mr. Pilsbry announced the finding, by Mr. Chas. Johnson, for the first time, in the Eocene of Texas, of a representative of the genus scalpillum. It is a new species for which the name Chamberlaini was proposed, in recognition of the services of the Rev. Dr. L. T. Chamberlain to paleontological science.

EDW. J. NOLAN,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB, APRIL 3.

DR. MARCY in chair. Prof. G. W. Hough presented the topic, 'Instruments for Recording the Time of Astronomical Observations.' He described various steps in the use of electric clock signals and the methods of mechanical record of such signals. After explaining a number of contrivances for securing uniform circular motion he described his printing chronograph, which prints with type the minutes, seconds, and hundredths of seconds of the time of the observation. The instrument has been in use since 1871, is easily kept in order, and has a great advantage over the recording chronograph in saving labor in meridian observations.

In the discussion Prof. Crew described devices used in securing uniform circular motion for chronographs at Johns Hopkins and at Lick Observatory.

A. R. CROOK,
Secretary.

EVANSTON, ILL.

NEW BOOKS.

Electric Lighting. Volume I. *The Generating Plant*: FRANCIS B. CROCKER. New York, D. Van Nostrand Co.; London, E. and F. N. Spon. 1896. Pp. viii+444.

Mathematical Papers read at the International Mathematical Congress. Edited by E. HASTINGS MOORE, OSKAR BOLZA, HEINRICH MASCHKE, HENRY S. WHITE. New York, Macmillan & Co., for the American Mathematical Society. 1896. Pp. xvi+411. $4.00.

Wages and Capital. F. W. TAUSSIG. New York, D. Appleton & Co. 1896. Pp. xviii +325.

Ruhmkorff Induction-Coils. H. S. MORRIE. New York, Spon and Chamberlain. 1896. Pp. xviii+183.

SCIENCE

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SCIENCE

FRIDAY, MAY 29, 1896.

CONTENTS:

*THE APE-MAN FROM THE TERTIARY OF JAVA.**

NEAR the beginning of last year, a discovery was announced that excited great interest throughout the scientific world, especially among those interested in the origin and antiquity of man. The announcement first made was that remains of a veritable missing link between man and the higher apes had been found in Java, in strata of Pleistocene age. The discovery was made by Dr. Eugene Dubois, a surgeon in the Dutch army, who had been stationed in Java for several years and had devoted much time to the vertebrate fossils of that island.

The first definite information received in this country was in December, 1894, when Dubois's memoir on *Pithecanthropus* arrived.† One of the first copies reached the late Prof. Dana, and at his request I wrote a review of it, which appeared, with illustrations, in the *American Journal of Science* for February, 1895.

The memoir of Dr. Dubois was an admirable one, and, although written in Java, with only limited facilities for consulting the literature on the subject, and for comparing the remains described with living

*Abstract of communication made to the National Academy of Sciences at Washington, April 24, 1896.

† *Pithecanthropus erectus.* Eine menschenaehnliche Uebergangsform aus Java. Von Eug. Dubois, Militairarzt der niederlaendish-indischen Armee. Mit zwei Tafeln und drei in den Text gedruckten Figuren. 4to, Batavia, 1894.

and extinct forms to which they were related, the author showed himself to be an anatomist of more than usual attainments and fully qualified to record the important discovery he had made. In my review, therefore, of this important memoir I endeavored to state fairly the essential facts of the discovery, as well as the main results reached by Dr. Dubois after a careful study of the remains. My own conclusions in regard to this discovery, briefly stated in my review, were as follows:

"It is only justice to Dr. Dubois and his admirable memoir to say here that he has proved to science the existence of a new prehistoric anthropoid form, not human indeed, but in size, brain power and erect posture much nearer man than any animal hitherto discovered, living or extinct. * * * Whatever light future researches may throw upon the affinities of this new form that left its remains in the volcanic deposits of Java during later Tertiary time, there can be no doubt that the discovery itself is an event equal in interest to that of the Neanderthal skull.

"The man of the Neander valley remained without honor, even in his own country, for more than a quarter of a century, and was still doubted and reviled when his kinsmen, the men of Spy, came to his defense, and a new chapter was added to the early history of the human race. The ape-man of Java comes to light at a more fortunate time, when zeal for exploration is so great that the discovery of additional remains may be expected at no distant day. That still other intermediate forms will eventually be brought to light no one familiar with the subject can doubt."

In most scientific quarters, however, both in this country and in Europe, Dr. Dubois's discovery was not received with great favor and the facts and conclusions stated in his memoir were much criticised. The early conclusions seemed to be that the various remains discovered were human and of no great age; that they did not belong to the same individual; that the skull apparently pertained to an idiot, and that both the skull and femur showed pathological features. In fact, the old story of the distrust aroused by the discovery of the Neanderthal skull, nearly forty years before, was repeated, although in milder form.

It was a fortunate thing for science that the Dutch government appreciated the importance of the discovery made in its Javanese province by Dr. Dubois, and last summer allowed him to return to Holland and bring with him the precious remains he had found and so well described. Not only this, but he was also permitted to bring the extensive collections of other vertebrate fossils which he had secured from the same horizon and in the same locality where the *Pithecanthropus* was discovered. All these were shown at the International Congress of Zoölogists, held at Leyden, in September last, and on the 21st of that month Dr. Dubois read an elaborate paper on his original discovery and on his later explorations in the same region. This communication was in many respects the most important one of the session, and its presentation with the specimens themselves was a rare treat to the large audience present, especially to those fitted to appreciate the evidence laid before them.*

Prof. Virchow, of Berlin, was president of the meeting on that day, and had brought various specimens to illustrate the remarks he was to make in the discussion. The famous Leyden museum was also drawn upon for an extensive series of specimens of man and the higher apes, so that, if possible, the true position of *Pithecanthro-*

* Compte-Rendu des Séances du Troisième Congrès International de Zoologie, Leyden, September, 1895, pp. 251–271, 1896. See also Transactions Royal Dublin Society, Vol. VI., pp. 1–18, February, 1896; and Anatomischer Anzeiger, Bd. XII., pp. 1–22, 1896.

pus might then be determined once for all. Dr. Dubois, moreover, kindly invited Prof. Virchow, Sir William Flower and myself to come an hour before the meeting and personally examine the remains he was to discuss, and this invitation was most gladly accepted.

The first sight of the fossils was a surprise, as they were evidently much older than appeared from the descriptions. All were dark in color, thoroughly petrified, and the matrix was solid rock, difficult to remove. The skull-cap of *Pithecanthropus* was filled with the hard matrix, firmly cemented to it. The roughness of the superior surface, especially in the frontal region, was apparently due to corrosion after entombment, and not to disease, as had been suggested by some anatomists. The femur was free from matrix, but very heavy in consequence of the infiltration of mineral matter. The exostosis on its upper portion was a conspicuous feature, but of course is pathological. This feature is of little consequence, as very similar outgrowths occur on fossil bones of even Eocene age. The two teeth showed no characters that indicated their interment under circumstances different from that of the skull or femur. All the physical characters impressed me strongly with the idea that these various remains were of Tertiary age, and not Post-Tertiary, as has been supposed. The description of the locality and the account of the series of strata there exposed, as given by Dr. Dubois in his communication, confirmed this opinion, and a later examination of accompanying vertebrate fossils placed the Pliocene age of all beyond reasonable doubt.

The facts relating to the discovery itself, and the position in which the remains were found, as stated by Dubois in his paper, together with some additional details given to me personally, convinced me that, in all probability, the various remains attributed to *Pithecanthropus* pertained to one individual. Under the circumstances, no paleontologist who has had experience in collecting vertebrate fossils would hesitate to place them together.

The three specimens originally described, the tooth, skull and femur, were found at different times in the same horizon, all imbedded in the same volcanic tufa, in the bank of the river Bengawan, near Trinil, in central Java. The tooth was found first, in September, 1891, in the left bank of the river, about a meter below the water level during the dry season, and twelve or fifteen meters below the plain in which the river had cut its bed. A month later, the skull was discovered, only a meter distant from the place where the tooth lay. In August, 1892, the femur also was found, about fifteen meters distant from the locality where the other specimens were imbedded. Later, in October of the same year, a second molar was obtained at a distance of not more than three meters, from where the skull-cap was found, and in the direction of the place where the femur was dug out.

The fossils thus secured were all carefully investigated by Dubois, who regards them as representing a distinct species and genus, and also a new family, which he has named the *Pithecanthropidæ*, and distinguished mainly by the following characters:

Brain cavity absolutely larger, and, in proportion to the size of the body, much more capacious than in the *Simiidæ*, yet less so than in the *Hominidæ*. Capacity of the skull about two-thirds the average of that of man. Inclination of the nuchal surface of the occiput considerably greater than in the *Simiidæ*. Dentition, although retrogressive, still of the simian type. Femur equal in its dimensions to that of man, and like that adapted for walking in an upright position.

Of this skull, the upper portion alone is preserved, the line of fracture extending from the glabella backward irregularly to the occiput, which it divides somewhat below the upper nuchal line. The cranium seen from above is an elongated oval in

guished from that of other anthropoid apes by its large size and its higher arching in the coronal region, as shown below in figures adult, but not very old, animal. The crown

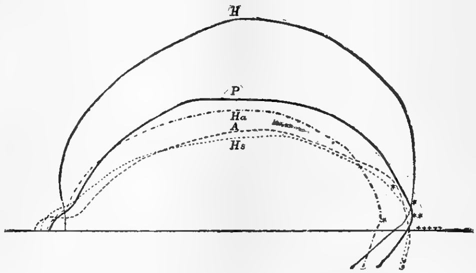


FIG. 1.—Longitudinal outlines of crania. H. European man ; P. *Pithecanthropus ;* Ha. *Hylobates agilis ;* A. Chimpanzee ; Hs. *Hylo- bates syndactilus.* (After Dubois.)

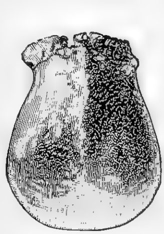
1 and 2. The greatest length from the glabella to the posterior projection of the occiput is 185^{mm}. The greatest breadth is 130^{mm}, and the smallest, behind the orbit, is 90^{mm}. The cranium in its original condition must have been of somewhat larger dimensions. The upper surface of the skull is without ridges, and the sutures all appear to be obliterated.

This dolicocephalic skull, with an index of 70°, is readily distinguished from that of the Orang-utan, which is decidedly brachycephalic. The absence of the characteristic cranial crests will separate it from the skull of the adult Gorilla. In its smooth upper surface and general form, it shows a resemblance to the skull of the Chimpanzee, and still closer to that of the Gibbons (*Hylobates*).

A figure of the present specimen and the skull of a Gibbon for comparison are shown in figures 2 and 3, below, reproduced from illustrations in Dr. Dubois's memoir.

The tooth, the first specimen found, is represented in figure 4, below. It is the last upper molar of the right side, and is in good preservation. It indicates a fully outline, dolichocephalic; and is distin-

is subtriangular in form, with the corners rounded, and the narrowest portion behind. The anteroposterior diameter of the crown



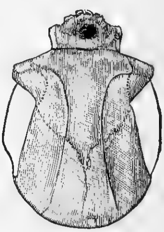


FIG. 2.—Cranium of *Pithecanthropus erectus*, $\frac{1}{6}$.

FIG. 3.—Skull of *Hylobates syndactylus*, $\frac{1}{3}$. (After Dubois.)

is 11·3^{mm}, and the transverse diameter 15·3^{mm}. The grinding surface of the crown is concave and less rugose than in existing anthropoid apes. The diverging roots are a simian feature.

The femur, which is from the left side, is in fair preservation, although it was somewhat injured in removing it from the surrounding rock. It belonged to a fully adult individual. In form and dimensions it resembles so strongly a human femur that only a careful comparison would distinguish one from the other.

These various remains of *Pithecanthropus* were again described in detail and compared with allied forms by Dr. Dubois in his paper at Leyden, and in the discussion that followed the whole subject was once more gone over by anthropologists, zoölogists and geologists in a most thorough and judicial manner. To attempt to weigh impartially the evidence as to the nature of *Pithecanthropus*, presented by Dr. Dubois in his paper and by those who took part in the critical discussion that followed its reading, would lead far beyond the limits

FIG. 4.—Third right upper molar of *Pithecanthropus erectus*, $\frac{2}{1}$. (After Dubois.)
a, back view; *b*, top view.

of the present communication. I can only say that this evidence was strongly in favor of the view that the skull of *Pithecanthropus* is not human, as the orbital and nuchal regions show, while at the same time it indicates an animal much above any anthropoid ape now known, living or extinct. Opinions differed as to whether the various remains pertained to the same individual, but no one doubted their importance.

The varied opinions expressed in regard to the anatomical characters of each of the specimens have already been published, and need not be repeated here. Dr. Dubois, in his papers above cited, has met all the principal objections made to his views since he announced his discovery. He has also given full reference to the literature, which promises to be voluminous as the importance of the subject becomes better known.

After a careful study of all the *Pithecanthropus* remains and of the evidence presented as to the original discovery, the position in which the remains were found, and the associated fossils, my own conclusions may be briefly stated as follows:

(1) The remains of *Pithecanthropus* at present known are of Pliocene age, and the associated vertebrate fauna resembles that of the Siwalik Hills of India.

(2) The various specimens of *Pithecanthropus* apparently belonged to one individual.

(3) This individual was not human, but represented a form intermediate between man and the higher apes.

If it be true, as some have contended, that the different remains had no connection with each other, this simply proves that Dr. Dubois has made several important discoveries instead of one. All the remains are certainly anthropoid, and if any of them are human the antiquity of man extends back into the Tertiary, and his affinities with the higher apes become much nearer than has hitherto been supposed. One thing is certain: the discovery of *Pithecanthropus* is an event of the first importance to the scientific world.

O. C. MARSH.

THE METRIC SYSTEM.

THE issue of SCIENCE for May 15th contains the report of a meeting of the Engineers' Club of Philadelphia, at which, by a vote of 100 to 60, the Club urges upon Congress the adoption of the metric system as the only legal standard in the United States, and the promotion of such international coöperation as will provide unity of practice among commercial nations.

In connection with this it may be of interest to note the issue of a circular entitled 'Should the metric weights and measures be made compulsory?' It is signed by J. Emerson Dowson, of London, who is a member of the Institute of Civil Engineers and Chairman of the Executive Committee of the New Decimal Association in England. This circular has been sent to various members of the American Society of Civil Engineers.

Mr. Dowson begins by quoting the now well-known recommendations of the Select Committee of the House of Commons, reported last July, in which it was urged that the metric system be at once legalized in England; that it be taught in all public elementary schools, and that it be rendered compulsory by act of Parliament after a lapse of two years. He discusses the reply of Mr. Balfour to the deputation of the Chamber of Commerce, who had urged upon him the need of giving effect to the recommendations of the Select Committee. Mr. Balfour expressed his high opinion of the merits of the metric system, but was unwilling that this should be made compulsory in the near future, because he feared the effect on the small retail dealers and those who buy their goods from such dealers, and thought that so important a change could not be well undertaken until public opinion is better prepared for it than at present. The metric system was legalized in America nearly twenty years ago, but in England its use is forbidden, under penalty, for purposes of trade. With us the pound and yard are defined as certain decimal fractions of the kilogram and meter, respectively, but neither legalization nor definitions are sufficient to secure general adoption until the people feel the need of discarding the inconsistencies and inconveniences to which they have become accustomed in the use of English weights and measures. Mr. Dowson's circular shows that among the plain business people of England there is an unexpectedly widespread demand for the change, in relation to which Mr. Balfour has shown himself so conservative. Soon after Mr. Balfour's reply had been given to the Deputation, the Metropolitan Grocers' and Provision Dealers' Association, a body composed chiefly of retailers, had a general meeting, discussed the metric system fully and critically, and passed a resolution, amidst applause, "That after due notice the system be made compulsory after two years." The Trades Councils throughout England seem to have taken a lively interest in the question. "At several of their meetings it had been discussed in a practical way; and at a Congress held in Glasgow, where there were 495 delegates, representing about a million and a quarter members and 418 different trades, a resolution in favor of the proposed change was carried unanimously, and the Parliamentary Committee was instructed to give it active support. These Trade Councils represented bargemen and watermen, dockers, street masons and pavers, gas workers and laborers, boot and shoe workers, lithographic printers, carmen, shop assistants, railway servants and many provincial trades." "The Incorporated Society of Inspectors of Weights and Measures have passed a strong resolution in favor of the proposed change. This Society represents the inspectors from all parts of the Kingdom and they have an intimate knowledge of what is best for the retail trades." "The County Council of Durham, representing a population of 750,000, voted unanimously in favor of the change; and one notable feature is that on this Council there are twenty working miners.'"

Mr. Dowson's circular is accompanied by a list of public bodies, associations, etc., which have approved the adoption of the metric system in England. This list is surprisingly large, and represents an amount of strength in behalf of progress much beyond what most of us Americans have credited to the conservative English. There are 20 town councils; 40 trade councils, including the London Association for the Protection of Trade, consisting of 4,000 members, the Edinburgh Merchants' Association, the Association of Trade Protection Societies, the Liverpool Cotton Association, Corn Trade Association, etc.; 29 School Boards, including those of London, Manchester and Birmingham; 39 Chambers of Commerce, including those of London, Edinburgh, Liverpool, Birmingham and Belfast; and 15 other influential bodies not easily classified, such as the National Union of Teachers, the Scottish Chamber of Agriculture, the Institution of Engineers and Shipbuilders, etc. Approval of the compulsory adoption of the metric system was carried at the Congress of Chambers of Commerce of the Empire, and at the recent annual meeting of the Association of Chambers of Commerce (March 25, 1896), when the Earl of Dudley assured the meeting that the London Board of Trade, of which he is Parliamentary Secretary, "realized the importance of the question and was determined to press it to an issue as soon as possible."

Apart from the inconvenience involved in change of any kind, the only really serious objection to the general adoption of the metric system is found in the great expense that is brought into large manufacturing establishments by a change of standards. The English are beginning to appreciate the loss they are suffering by lack of harmony with most other European nations, and loss of trade soon teaches what expense may be afforded in changing standards. The facts brought out in Mr. Dowson's circular seem to show that in England at present the popular demand for the metric system is greater than it is in America, although as a people we are less conservative than the English. Despite the temporary discouragement lately suffered by the advocates of progress in metrology, the outlook among English-speaking peoples is, on the whole, far better than it has ever been in previous years; and without being unreasonably sanguine there is yet good ground for the expectation that in both England and America the metric system will have been adopted by popular demand with the opening of the twentieth century.

Lord Kelvin's letter to the *London Times*, quoted in the last issue of SCIENCE, deals with this subject in a spirit eminently characteristic of its author and worthy of special commendation to American legislators. It thoroughly disposes of Mr. Balfour's consideration that the introduction of the metric system would bring hardship upon the poorer classes, "who have no great power to make their voices heard, at least in such discussions as these." Any argument based on the interests of these classes in England is equally applicable in America or in Germany. Those of us who have dwelt some time in Germany have noticed how thoroughly the poorer classes have adapted themselves to the metric system. There is certainly no record of their having suffered any unreasonable hardship. Indeed this is the old argument against the introduction of all labor-saving devices. If it had prevailed we should not to-day be using the power loom, the cotton gin, the steam engine or the printing press, because each of these threw some of the poorer classes out of employment, or necessitated inconvenient change of employment for them.

In the present case, moreover, there is no special need that the poorer classes should 'make their voices heard.' To form any opinion upon the merits of the metric system it is necessary to have some knowledge of it practically. Any one who has such knowledge, if he belongs to the poorer classes, should be accorded the opportunity to be heard. In America every one, however poor he may be, has access to the public ear through the daily press if he has the ability to write intelligibly. But the poor and the uneducated cannot be expected to take any active part in discussions of this kind, any more than in the founding of universities or the establishment of monetary systems. If we wait for them to speak out we must wait indefinitely. If the introduction of the metric system be accomplished in America we must act in the light of experience already acquired in Europe, which is far more valuable than any amount of theorizing about the apprehended effect upon poorer classes who have not yet tried it.

The suggestion that an International Commission should be appointed to secure unity of action between the United States and Great Britain is eminently worthy of adoption. Any system of metrology adopted by one of these two nations must necessarily be adopted nearly, if not quite, simultaneously by the other. It is very much to be desired that this proposition shall be brought before Congress as soon as the Committee on Coinage, Weights and Measures is again ready to act.

W. LE CONTE STEVENS.

TWO EROSION EPOCHS—ANOTHER SUGGESTION.

HERSHEY'S recent suggestion (SCIENCE, Vol. III., pp. 620-622) that a specific designation be given to the epoch of post-Lafayette erosion in the eastern United States is an excellent one. The epoch is one of the most clearly defined in the physical history of the continent; its record has already been interpreted over a vast area, and a specific designation will tend at once to crystallize knowledge and to aid in its diffusion. So the suggestion marks an advance in systematizing American geology.

To the writer the name selected seems hardly a happy one, partly because 'Ozark' is already in so general use in geologic nomenclature as perhaps to occasion confusion, partly because there is a certain incongruity in applying the name of a mountain region to a degradation period; but this question of fitness in name gives no occasion for hesitating to adopt the suggestion.

There is a graver question concerning the age of the epoch. Hershey intimates, without argument, that there is 'general agreement * * * that the post-Lafayette period of erosion is early Quaternary in age;' but, so far as the writer is aware, most students have connected the degradation period with the preceding aggradation period—those geologists who have examined the formation and its degradation record (with perhaps two exceptions) regarding both as pre-Quaternary, and those who have written voluminously on the formation without seeing it regarding it as Quaternary. It seems worth while to direct attention to this question of age, partly for the purpose of pointing out that there is no less need for the term even if the epoch does not belong to the Pleistocene, and thus to the period so well classified by Chamberlin; it is not absolutely necessary to decide whether the Ozarkian epoch be classified as Pleistocene or Neocene, since each student can arrange his pigeon holes and their contents as he pleases, and since increasing knowledge is constantly making toward better arrangements; but it is important that this well-marked erosion epoch should bear a denotive label. It is also important to remember that, if erosion be regarded as yielding a time measure, the reference of the Ozarkian to the Pleistocene multiplies many times the commonly recognized duration of that period.

Hershey adequately recognizes the extent of the erosion affected during the Ozarkian epoch in (a) the Coastal plain of the Atlantic and Gulf, and (b) the broad area extending thence to the glacial margin; but it seems desirable to recognize (hypothetically perhaps, but with constantly increasing evidence), the record of the epoch in (c) the glaciated region: In the Coastal plain this epoch of profound erosion is recorded in estuaries hundreds of miles in length and scores in breadth, and scores or hundreds of feet in depth to the bottom of later linings, excavated chiefly in nonlithified deposits; in the interior area it is recorded in steep-bluffed canyons carrying all the rivers and all but the smallest streamlets, excavated in hard rocks; and the two records are not only consistent in kind and amount, but intergrade in such manner as to establish substantial identity. In the glaciated area the drift mantles a surface, which, so far as outcrops and borings indicate, is the counterpart of that found in the extra-glacial region, *e. g.*, in Ohio and western Pennsylvania numerous ancient drift-filled channels have long been known; in Indiana and Illinois many such canyons have been revealed by borings; in Iowa several have been recognized for years and others have recently been brought to light through the researches of the State Survey; indeed throughout most of the glaciated region such buried canyons are known. Now it is noteworthy that all of these drift-filled gorges thus far brought to light are consistent in depth and width among each other, and also with the gorges of the Mississippi, Missouri and Ohio, not only inside the glacial boundary, but outside that limit where they form trustworthy records of the Ozarkian epoch. It is no less noteworthy that Salisbury and others have detected remnant gravel deposits, presumptively representing the Lafayette, far within the glacial boundary; and the combined records of aggradation and degradation indicate with considerable clearness that the continental oscillations of the Lafayette-Ozarkian time affected most or all of what is now the eastern half of the United States. This correlation of degradation records without and within the glacial boundary explains simply and readily the peculiar configuration of the pre-glacial surface which has puzzled many students; and at the same time it emphasizes the strong distinction between agencies and conditions of the two periods—the Ozarkian epoch of high level and rapid degradation, and the Kansan and succeeding epochs of low altitude and aggradation or feeble degradation.

In considering the physical history of the southeastern quarter of the continent during neozoic time it should be borne in mind that there were two and only two great eons or cycles of earth movement. The first eon began with the profound oscilliations attending the deposition and subsequent degradation of the Potomac formation, continued with ever-lessening amplitude of oscillation nearly to the end of the Tertiary, and closed with the remarkable epoch of stability in the earth crust antedating the Lafayette; the second eon began with the profound oscillation by which the deposition and subsequent degradation of the Lafayette were produced, continued with diminishing vigor and amplitude of movement to the end of glacial time, and is apparently not yet closed, *i. e.*, each cycle began with strong movement which gradually declined and died away, the first in a long epoch of quiescence, the second in the gentle oscillation apparently in progress to-day. It may be noted in passing that there is a certain logical symmetry and completeness in correlating these eons or cycles with the stratigraphic and paleontologic series, and thereby in referring the second wholly to Pleistocene; but it should not be forgotten that there is no indubitable evidence connecting the Lafayette with glacial action, and a vast body of trustworthy evidence pointing in the opposite direction, so that the logic of fact runs counter to the logic of idea; moreover such a correlation tends to deepen the slough of baseless speculation concerning the cause of glaciation which alone seems to connect the Lafayette with the glacial deposits. Now on considering in detail the oscillations of the two eons, it is found that they run in pairs, each subsidence being followed by elevation of proportionate amount; * *e. g.*, the strong subsidence of the Potomac epoch was followed by a strong uplift, the slight subsidence of the Pamunkey by a slight uplift, and in the Lafayette and again in the Columbia epoch the same relation held, while the values of subsidence and elevation varied together in different latitudes, yet remained essentially equal at each. So uniform and so constant is this relation that it seems fitting to couple each degradation period with the immediately preceding aggradation period rather than with that which followed; in other words, each unconformity seems more closely related to the formation in which it is carved, than to the newer, perhaps much newer, formation overlying it. These considerations indicate the conditions of the erosion epochs preceding and succeeding the Lafayette; and incidentally they seem to afford additional grounds for classing the Ozarkian epoch with the Neocene rather than with the Pleistocene.

There is satisfactory evidence† that as the oscillating earth crust came to approximate rest in the earlier physical eon, the land surface throughout the Piedmont, Appalachian, Cumberland and contiguous provinces was extensively baseleveled and so far degraded that mechanical agency became feeble; this was the epoch of widespread planation by which character was given to the inter-stream surface outside the glacial margin, and presumptively to the inter-canyon surface in the glaciated area. As mechanical activity decreased chemical activity increased, and the less obdurate rocks were decomposed into a thick mantle of residua, interrupted by occasional siliceous ledges and bodies, which were afterward gathered by the revived streams to form the Lafayette deposit. This epoch of baseleveling and rock decomposition was of exceeding importance in the geologic history of the southeastern part of the continent, since it was during its course that the chief topographic features of the provinces—the broad plateaus and inter-stream plains—were developed. Its earlier limit is indeed somewhat vague; the characteristic processes began with the waning post-Potomac oscillation, and were measurably interrupted by each throe of the earth crust up to and including the Chesapeake, in the middle Atlantic slope; but its later limit is clearly fixed by the Lafayette.

It seems desirable that this important degradation epoch should receive a distinctive appellation. The association of Hershey's designation would suggest Appalachian, or Piedmont, or Cumberland as a suitable term, since the configuration of these provinces was shaped during the epoch; but it would seem to the writer more fitting to borrow a name from one of the principal agents in the work of the epoch, viz: Tennessee river—a great waterway which then drained a large section of the Cumberland and Appalachian provinces directly into the Mississippi, which was of much greater importance in the earlier neozoic epochs than at present, and which assumed a new course in its lower part and lost much of its drainage area as the epoch ended.

So it may be suggested that *Tennessee* (*or Tennesseean*) *epoch* be added to the time nomenclature of American geology as a designation for the long period of planation and rock decomposition immediately preceding the Lafayette. Thus may we have convenient designations for the two chief erosion periods by which the lands of a vast area of our continent were finally shaped.

* The characteristics of the movements have been noted in the Compte Rendu de la Congress Géologique International, 5me. Session, Washington, 1891, p. 165.

† Noted in part in Twelfth Ann. Rep. U. S. Geol. Survey, 1891, pp. 494–6, 508; also in descriptive text of the Nomini Atlas-folio (now in press) of the Geologic Atlas of the United States.

The relations of the epochs, as conceived by the writer, are shown in the following scheme :

Period.	*Epoch.*	*Process.*
Pleistocene	Wisconsin	Glaciation.
	Toronto ?	Aqueous erosion, etc.
	Iowan	Glaciation.
	Aftonian	Aqueous erosion, forest growth, etc.
	Kansan	Glaciation.
Neocene	Ozarkian	Canyon cutting.
	Lafayette	Sedimentation.
	Tennessee	Planation.

Save occasionally in the Appalachian and Piedmont provinces, where the normal land forms are locally dominated by structural mountains, monadnocks and catoctins, the topographic record of the two Neocene erosion epochs stands out in every typical landscape from the fall-line to the drift margin; for the characteristic tabular or gently-rounded, residuum-mantled divides represent the earlier, and the no less characteristic steep-bluffed labyrinthine gorges represent the later epoch. The even-topped ranges and outlying monadocks record earlier episodes in continental development, as Davis, Hayes, Campbell and others have shown; but the record found in the relatively modern plateaus and gorges is many times the more extensive and impressive.

Howsoever the Ozarkian be classified, it is evident that the erosion epochs of the Pleistocene and Neocene were long, especially in the earlier time. Recent researches, notably by Chamberlin and others in the interior and by Salisbury in New Jersey, indicate that the Toronto epoch was much longer than the post-glacial epoch; and it has for some time been recognized by a number of glacialists that the interglacial epoch called Aftonian was much longer, as measured by erosion, than all those that have followed—or, at any rate, that the Kansan was many times more remote than the Wisconsin. Yet the erosion of the Toronto and Aftonian together is trifling in comparison with the profound and widespread canyon-cutting of the Ozarkian, during which the streams and larger rivers of the southeastern sub-continent cut gorges averaging 250 feet in depth and ranging from a few rods to several miles in width; and even this enormous erosion is slight in comparison with the widespread wasting of the Tennessee epoch.

W J MCGEE.

CURRENT NOTES ON PHYSIOGRAPHY.

GEOGRAPHICAL DESCRIPTION OF THE BRITISH ISLANDS.

DR. H. R. MILL gives in the April *Geographical Journal* an account of his plan for a series of memoirs, one for each sheet of the one-inch ordnance survey, describing the geography of the British Islands in a most comprehensive manner. Index of names and locations, mean elevations, hypsographical description, physiographical explanation, areas of woodland, moorland, cultivated land, etc., political and historical boundaries and events, geographical description proper, and bibliography, are to be duly considered. The plan was favorably commented on at a meeting of the Royal Geographical Society, and it does not seem impossible that it may be carried into execution.

The remark made under 'historical information' might be applied to all parts of the plan: It 'would be very stringently edited, so as to confine it strictly to those features and events of direct geographical importance,' for an inspection of current geographical literature shows how vague is the prevalent conception as to the essential quality of geographical discipline. Local floras and faunas, one of the proposed topics, are distinctly not geographical, but biological subjects. Treated with relation to the controls of their distribution, they gain geographical flavor. Treated as exhibiting geographical controls, they become as distinctly geographical as are any other means of impressing the facts concerning the earth's surface. It may be questioned whether the 'mean elevation of areas between successive contour lines' is a worthy object of geographical as contrasted with arithmetical study. It only produces confusion to tabulate under one heading a steep and a flat slope of the same limiting altitudes; but it is quite otherwise with the summation of steep and of flat areas, under appropriate but not arbitrary limits of height. A remark under this heading also might be generally applied to the whole project: "It would be very suitable as an exercise and training for students, if any institution existed in this country where students would be induced to study geography seriously." The geographical description "would be the most important part of the memoir, and must be the work of a trained geographer. * * * It would deal directly with the relation of the people to the land, showing the control exerted by geographical conditions on the sites of towns, on dwellings, occupations, the distribution of the people, the lines of communication."

Let us hope that Dr. Mill's excellent project need not wait until that distant time when trained geographers are found, ready made; but that the Royal Geographical Society will at once announce that it is ready to publish chapters of these memoirs, by whomsoever prepared, but accordant with a systematic and comprehensive plan, and approved by a committee of editors. Almost any one of the chapters might be chosen as the subject for a candidate's thesis for his doctorate, and this kind of encouragement of serious geographical study might well serve as the thin end of the wedge that shall farther open up the proper development of geography in the English universities.

RECENT SHEETS OF OUR NATIONAL MAP.

THIRTY odd sheets of the topographical map, in preparation for our national geological atlas, are lately added to the growing list of surveyed areas. The limestone country of Florida is revealed as showing typical '*Karst*' forms, without continuous valleys, but discharging its surface waters by underground channels, entered through sinkholes. Although a faint relief, it rivals in perfection of this kind of form the more famous *Karst* district of Carniola. Kingfisher sheet, Oklahoma, exhibits a peculiar relation between Cimarron river, on the north, and the North fork of Canadian river, lying twenty miles further south and 300 feet higher; the branches of the former river heading within two or three miles of the latter and bidding fair to capture and divert it at various points. The downstream deflection of tributary streams is well illustrated in the case of Bird creek, which, when less than half a mile from the Cimarron, turns and flows six miles southeast along the margin of the flood plain before entering the main river, and indeed then enters it only because the river crosses to the southern side of its flood plain and picks the tributary up; thus repeating on a small scale the much larger example of the Yazoo and the Mississippi. The Oneida and Oriskany sheets, N. Y., might be commended to the author of the statement that "three distinct mountain masses enter New York from the south and extend across it in a general northeast direction." These sheets show in part the definite northern termination of the Alleghany plateau south of the Mohawk valley, in bluffs that ascend six or seven hundred feet. The second sheet includes the greater part of the 'long level' in the Mohawk valley, below Rome; of particular interest as the outlet of the expanded Lake Ontario in late glacial times. Many other sheets equally deserve comment.

A SHORT HISTORY OF THE GREAT LAKES.

UNDER the above title, F. B. Taylor is contributing several articles to the *Inland*

Educator (Terre Haute, Ind.) in the hope of cultivating an appreciative study of local physiography in the Indiana schools. In the April number, two outline maps exhibit hypothetical restorations of several stages of the glacial lakes in relation to the moraines, the retreating ice front and the temporary outlets. As several of the terminal moraines constitute the most important local reliefs of the level prairies of Indiana, and as one of the earlier lakes overflowed across northern Indiana to the Wabash and thence to the Ohio, passing the site of Fort Wayne, the subject is a pertinent one for an educational journal, and deserves more emphasis than it commonly receives in the schools. The Science department of the *Educator*, conducted by Prof. C. R. Dryer, of the State Normal School at Terre Haute, proposes to follow Taylor's essay with others of local physiographic bearing prepared by investigators of acknowledged competence, and in this plan they set a good example that deserves imitation.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON METEOROLOGY.

WEATHER BUREAU KITE-FLYING.

THE past year has witnessed a very notable development in scientific kite-flying in this country. In Washington the Weather Bureau has, under the direction of Prof. Willis L. Moore, Chief of the Bureau, been carrying on an extended investigation into the best kinds of kites for use in sending up meteorological instruments. Prof. C. F. Marvin has recently minutely described the kind of kite now in use by the Bureau (Mo. Weather Rev., Nov., 1895). This kite is a modification of those used by Hargrave in Australia, and is not at all like the ordinary kite. Instead of being flat, and tapering at the lower end, as in the usual form, these kites are box-shaped, with their ends open and their sides partly covered with cloth or silk. This style of kite, which has also been in use at Blue Hill for some months, is found to be admirably adapted to the purpose for which it is intended, and when fine piano wire is used to hold it, instead of twine, is a splendid flyer. The next few years will undoubtedly witness many improvements in kites used for meteorological purposes, and the United States seems to be distinctly in the lead in this work at the present time.

BALLOONS AND KITES IN CLOUD OBSERVATIONS.

IN connection with the cloud observations to be made during the International Cloud Year (see SCIENCE, May 1, 1896, 661) the suggestion is made by Kremser (Meteorologische Zeitschrift, April, 1896, 143–144) that the extended use of small pilot balloons would result in giving us much valuable information as to the air currents in and around clouds. These balloons, which can be made at slight expense, reach considerable altitudes, and are especially useful in indicating the drift of the air currents when there are no clouds in the sky, the direction of the lower currents when only upper clouds are visible, etc. Clayton, of the Blue Hill Observatory, has for some time been using kites to help in determining the altitudes of the base of stratus and nimbus. These clouds, which so often cover the whole sky with a uniform sheet, can only have their heights determined under the most favorable circumstances if the ordinary theodolite is used.

BLUE HILL KITE-FLYING.

THE work done at Blue Hill Observatory with kites was outlined by Clayton before the Boston Scientific Society at a recent meeting (Boston Commonwealth, May 9, 1896, 12–13). The kites at present in use are the Eddy, or tailless, and the Hargrave, or box kite. Continued experiments at Blue Hill have resulted in the development of scientific kite-flying on a remarkable scale. Recent ascents have reached altitudes but little short of a mile above sea level, and excellent records have been obtained by means of a self-recording instrument made by Fergusson, of the Blue Hill staff, which gives automatic readings of temperature, pressure, humidity and wind velocity. Mr. Rotch, the proprietor of the Observatory, has now had constructed for him by Richard *Frères*, of Paris, an aluminum instrument weighing less than three pounds, which records pressure, temperature and humidity. The meteorological results already obtained are of great value, and the full discussion of them is awaited with interest. Among the most important matters that have been noted is the presence of cold waves and warm waves at considerable elevations some hours before the temperature changes are noted at the earth's surface. The prospect of improving our weather forecasts by such soundings of the free air is very encouraging, and it is more than likely that before long some practical use will be made of these discoveries.

Harvard University. R. DeC. Ward.

SCIENTIFIC NOTES AND NEWS.

The fifth session of the Hopkins Seaside Laboratory, of Stanford University, will open on June 15th. It will continue for six weeks, but investigators may remain in residence throughout the summer. The laboratory, which includes two buildings well equipped for instruction and research, is located at Pacific Grove, on the Southern shore of Monterey Bay, about four hours' distant from San Francisco. To investigators prepared to carry on original work the use of the Laboratory and its equipment is tendered free of charge, and its location offers unusual advantages to students from the Eastern States wishing to become acquainted with the fauna and flora of the Pacific. The laboratory is under the direction of Professor O. P. Jenkins and C. H. Gilbert, with the assistance of other instructors from Stanford University.

Mr. Griffith, Secretary of the British Association for the Advancement of Science, is now in America to make arrangements for the meeting of the British Association in Toronto in 1897. On May 19th he was the guest of Prof. Putnam, Permanent Secretary of the American Association for the Advancement of Science. The two Secretaries passed the morning in discussing various matters relating to their respective Associations. It is the intention of the American Association to arrange the time and place of its meeting next year so that members of the American and British Associations can attend both meetings, and as the British Association will probably hold its meeting on August 18–25 it is suggested that the American Association hold its meeting August 30 to September 4. A few Harvard professors, prominent in the Association, met Mr. Griffith at the Colonial Club, and the afternoon was spent in visiting several departments of Harvard University. On Wednesday Mr. Griffith visited the Harvard Medical School and other places o interest in Boston, and in the evening he left for Ottawa in order to meet the members of the Royal Society of Canada before their adjournment on Friday. From there he goes to Toronto to arrange with the local committee for the meeting of the British Association.

The Secretary of the Smithsonian Institution has leased for another term of three years, for the benefit of American students, one of the tables at the Naples Zoölogical Station. This was done in response to requests from a large number of colleges and universities, and to resolutions from the principal natural history societies in the country, and a petition signed by over four hundred biologists. During the last three years the following universities and colleges have been represented; that is to say, the occupants of the Smithsonian table have been either graduates of those universities or professors in their faculties :

Clark University, Worcester; University of Chicago; Brown University; University of Michigan; Kentucky State College; John Hopkins University; Kansas Agricultural College; Bryn Mawr College; Wesleyan University; Iowa Agricultural College; Leland Stanford Junior University; Olivet C llege, Michigan.

The candidates for the privileges of the Smithsonian table are recommended by a committee composed of representatives of the *National Academy of Sciences*, *American Morphologists*, *Society of American Naturalists* and the *Association of American Anatomists.*

MR. HERBET SPENCER has recently communicated to the *London Times* a series of letters opposing the adoption of the metric system and advocating a reorganization of the present duodecimal system in preference to a change which would adjust our weights and measures upon a decimal system.

WE noted last week that in the occasion of its millenial celebration the University of Buda-Pesth will confer an honorary degree upon Dr. John S. Billings. It is said that degrees will not be conferred on any other Americans and only on four Englishmen: Lord Kelvin, Mr. Herbert Spencer, Prof. Max Müller and Mr. James Bryce.

PROF. W. K. BROOKS has been elected Fellow of the Royal Microscopical Society.

A TELEGRAM to the New York *Evening Post* states that there has been a volcanic eruption on the island of Socorro, off the Mexican coast. Two months ago, which is the latest date of news received, lava was running down the mountain sides, overflowing the lowlands and moving towards the sea.

GOV. MORTON has signed the bill authorizing the use of the land now occupied by the old reservoir at Forty-second street and Fifth avenue in New York City for a free public library and reading room, to be erected under the supervision of the New York Public Library, the combination of the Astor, Lenox and Tilden foundations.

A NEW law authorizes the Brooklyn board of estimate and apportionment to grant $100,000 payable on the Mayor's order, to any corporation depositing an equal amount with the City Treasurer for the purpose of a free public library.

PROF. KEMP and Prof. Peale, of Columbia University, will conduct the summer work in geology and mining of the School of Mines at Butte, Montana. Prof. Scott, of Princeton University, will conduct a geological expedition which will have its headquarters at Flagstaff, Arizona.

PROF. D'ARCY THOMPSON and Mr. Barrett Hamilton have been appointed by the British government as the naturalists to investigate the seals in Behring Sea. They are now on their way to the United States.

THE British Government, in recently distributing a number of sets of the Challenger Reports to scientific institutions, selected on the advice of the council of the Royal Society, sent five of the sets to the United States. The Institutions which receive them are the Universities of California, Tulane and Colorado, the Woods Holl Laboratory and the Hydrographic Bureau of the United States Navy.

THE Museum of Practical Geology, London, will be opened on Sunday, from 2 p. m. to 7 p. m., as an experiment, the continuance of which will depend on the attendance of visitors.

AN International Congress of Agriculture will be held at Buda-Pesth in connection with the Millenial Exposition. An International Horticultural Exposition will be held at Hamburg from May to October, 1897. The sum of $100,000 has been appropriated for the purpose by the city.

THE publication is announced of a journal in Milan devoted to acetylene and its applications.

THE *British Medical Journal* states that the Koch Institute is not to be transferred to Dahlem after all. The Prussian government has decided to buy a plot of land close to the ground on which the new fourth municipal hospital is to be erected—in the See Strasse—and to build an enlarged and improved Koch institute upon it. The decision, simple as it seems, has been arrived at only after long and wearisome negotiations. Now it is hoped that, this knotty point once solved, the rebuilding and enlargement of the Charité Hospital will be attacked in earnest. The ground at present occupied by the Koch Institute is required for the hospital, but of course, until the future of the institute itself had been definitely settled, it was impossible to begin work. A new museum for the pathological collections is urgently needed, as Virchow is terribly cramped in the Pathological Institute. It is said that 1896 is to see this building begun; but delays have been so frequent that it is best not to prophesy.

Nature states that M. Moisson is reported (*Centr. Zeit. für Opt. u. Mech.* xvii. 6) to have discovered a substance harder than the diamond in the form of a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of 5,000°. This compound is black and not unlike graphite in appearance, and it appears likely to supersede diamonds for boring rocks, cutting glass and other industrial purposes. It will even cut diamonds without difficulty, and it can be produced in pieces of any required size.

IT is reported that the metric system has been legally introduced into Turkey, and that the Russian Minister of Commerce recommended its consideration at the recent Industrial Congress.

IT appears from *La Vie Scientifique* that 'La société française de physique' has recently held in Paris an exhibition similar to the recent *Converzatione* of the Royal Society and the exhibition of the New York Academy of Sciences. Röntgen photographs, the manufacture of acetylene, applications of aluminum and other recent advances in scientific apparatus were exhibited.

Natural Science states that a summer meeting of the Anatomical Society of Great Britain and Ireland will be held at Oxford on Saturday, July 4th. This Society, which was founded in 1887, meets, as a rule, four times a year, three of the meetings being held at the London medical schools in rotation, and the other at one of the provincial universities or schools.

MACMILLAN & Co. announce 'An Intermediate Course of Practical Physics,' by Prof. Arthur Schuster, F.R.S., and Dr. C. H. Lees.

THE death is announced of the Abbé Delaney, a missionary in China, who discovered and introduced into Europe a large number of undescribed species of plants.

M. GERMAIN SÉE, the eminent French pathologist, has died at Paris at the age of 77.

LIEUT. PEARY will embark from Cape Breton in July, in a steamship under the command of Captain John Bartlett, which will proceed to Cape York, where Lieutenent Peary last year discovered a meteorite said to be the largest in the world. If the conditions are favorable he may go further north to his former headquarters on Inglefield Gulf. Prof. Ralph S. Tarr with a party from Cornell University will be taken by the steamship to some point in Greenland, where they will remain while the steamship goes further north.

DR. WASHBURN writes to the London *Times* from Constantinople that on Saturday evening, April 18th, at 7 o'clock, as the M. M. steamer Sindh was passing to the south of the island of Cyprus, a brilliant meteor was seen, which appeared to burst just over the island. It seemed to be in all respects an exact duplicate of the meteor which was seen at Madrid several months since. It started about 30° from the zenith, took a direction of about 80° from the horizon, and burst when about 20° from the horizon. For 15 minutes, three zigzag lines of silver light marked its course, and the fiery cloud when it burst did not disappear for half an hour. This appeared to be about 2° in diameter, was very brilliant for some minutes, and then slowly faded. The sight was so startling that those who saw the meteor did not notice the sound of the explosion, but several persons noticed the explosion who did not see the meteor.

THE Hydrographic Office has issued a chart of the Arctic regions prepared under the direction of Commander C. D. Sigsbee. It extends to about 4° south of the Arctic circle, showing the tracts of seventy-six expeditions, and indicating forty-eight explorations of coasts.

A SUMMER session of the New York State Library School, which will take up the elementary principles of library economy, will begin on July 7th and last five weeks.

SIR WILLIAM PRIESTLEY, a well-known physician and writer on medicine, has been elected a member of the British Parliament representing the universities of Edinburgh and St. Andrew.

THE Duke of York has been elected president of the Royal Agricultural Society of Great Britain. The Society has received a bequest of $50,000 by the will of the late Mr. E. H.

Mills. At the country meeting to be held at Manchester prizes are offered by the Society for self-moving vehicles.

AT a meeting of the Philosophical Society of Washington on May 23d the following biographical notices of deceased members were expected: Thomas Antisell, by H. W. Seaman; Stephen Vincent Benet, by Rogers Birnie; J. Mills Browne, by Robert Fletcher; Thomas Lincoln Casey, by B. R. Green; Robert Edward Earll, by G. Brown Goode; William Lee, by D. Webster Prentiss; Walter Lamb Nicholson, by Edward Goodfellow; Orlando Metcalfe Poe, by O. H. Tittman; Charles Valentine Riley, by L. O. Howard; William Bower Taylor, by W. J. Rhees.

THE attention of those who are interested in the history of human progress (it is a pity that we lack the German word *Culturgeschichte*), in its forward and backward currents, should be called to a book of absorbing interest, *Woman Under Monasticism*, by Lina Eckenstein (Macmillan). It gives a vivid picture of the convent life of women during the period between 500 and 1500 A. D., in Germany and England, with special biographies of those nuns and abbesses who exerted an important influence upon the life of their times; but its chief value is in showing that the present effort of women to obtain a greater share of social responsibility is a return to conditions which were the established state of things a thousand years ago. The convent afforded a career for those who felt themselves capable of wider activities than were involved in the care of the household, and a career of greater influence and power than has been open to women, of other than royal descent, under any other circumstances. The closing of the monasteries, by compelling all women to marry, acted injuriously upon human development in more ways than one, even though its effect may have been on the whole desirable. That there is an historical basis for the present movement toward greater independence on the part of women is a matter of much importance.

AT a recent meeting of the Anthropological Institute of Great Britain, Professor E. B. Tyler commented upon Mr. Howarth's paper on 'The Asiatic Element of the Tribes of Southern Mexico,' drawing attention to the difficulty of defining the meaning of the word 'prehistoric' in America. He remarked that the picture writings exhibited by Mr. Howarth were wonderful examples of the authentic Aztec, side by side with the imported Spanish element, the exact proportion of which was, however, exceedingly hard to distinguish. In the United States, he continued, many anthropologists, headed by Dr. Brinton, support a kind of 'Anthropological Monroe Doctrine,' according to which America admitted no extraneous contributions to her culture. The conflict of this theory with the older doctrine gives promise of a good fight in the future, should he still remain constant to the older theory. He found it very difficult, on the new Monroe doctrine, to account for such things as the astronomical calendar. He, nevertheless, favored dropping, for the present, such questions as Egyptian derivation, in favor of the investigation of nearer links in the chain.

IT is stated in the daily papers that Profs. Cox and Calendar, of the McGill University have reported to the Canadian Royal Society that they have made experiments showing that the X-rays are deflected by magnetic influence. It is also said that Prof. Dorn and Dr. Brandes, of the University of Halle, have proved that the X-rays affect the retina, it having been demonstrated in the first instance in the case of a patient the lenses of whose eyes had been removed. Later it is said that they were themselves able to see the rays, looking at their source through an aluminum plate.

A COMPLETE edition of the works of Descartes will be published by the French Ministry of Public Instruction, under the auspices of the 'Revue de Métaphysique et de Morale' 5 rue de Mézières, Paris. Five volumes will be devoted to the correspondence, including letters addressed to Descartes as well as those written by him, and five volumes will be devoted to his published works. The publication will be begun this year and will be completed in 1900. A deduction of 40 per cent. in the price will be made to those who send subscriptions in advance to the above address.

WE learn from the *American Geologist* that the question as to the desirability of retaining the museum of the London Geological Society has formed the subject of long deliberations by the Council of the Society. It was announced at the recent annual meeting that, in accordance with the report of a special committee, the trustees of the British Museum had been asked whether they would undertake to house and care for the collections, keeping type-specimens and specimens illustrative of papers read before the Society distinct, and defraying also the expense of transference. To these conditions the trustees have assented, and the matter will before long be submitted to the Fellows for their decision at a special general meeting.

MR. S. E. DUERDEN contributes to the May number of *Natural Science* an article on 'Museum work in Jamaica,' in the course of which he says that the museum in Jamaica is one of the components of the Institute of Jamaica, an organization existing for the advancement of Literature, Science and Art in the island; and embracing also a well-established public library and reading room and an embryonic art gallery. It is managed by a Board of Governors, and practically the whole support is derived from the Legislature. Members are elected with certain privileges, and members' meetings are held. A journal devoted to the special objects of the institute is published at intervals. Courses of public lectures on science and literature, on the lines of the University Extension courses in England, are arranged from time to time. In almost every department of biological enquiry Jamaica and the West Indies generally offer a very rich but only partially investigated field for research. A vigorous attempt was made a few years ago to form a marine laboratory upon a large scale, with the special object of affording facilities to foreign biologists in studying tropical life, but unfortunately the scheme fell through, largely because of its too ambitious nature. However, a biological laboratory with most modern appliances for carrying on scientific research, and a dark room for photography, have lately been fitted up in connection with the Museum.

THE Congress of Criminal Anthropology to be held at Geneva from the 24th to the 29th of August will meet in five divisions entitled (1) criminal biology, (2) criminal sociology, (3) criminal psychology, (4) legal applications of criminal anthropology, (5) administrative applications of criminal anthropology. A large number of interesting papers have already been promised, including communications from Mr. Galton, M. Tarde, Prof. Kurella, M. Bertillon, Dr. Brockway and others.

ACCORDING to the authorized announcements of the University of the State of New York in 1888 only five states in the Union exacted an examination for license to practise medicine, and the laws of these States were crude and imperfect and for the most part inoperative. A licensing examination is now required in 22 States. In fact, if we count Texas, whose laws conflict, the roll includes 23. Of these examinations, 16 are before a single board; 4 before 2 boards, allopathic, homeopathic; 3 before 3 boards, allopathic, homeopathic and eclectic. In 11 of these States candidates for examination must be graduates of medical schools; in 3 of these 11 States they must have studied medicine for 4 years; in 2 States they must have attended at least three courses of medical lectures, though a diploma is not required. One of these two States, Minnesota, will require four courses of lectures, but not a diploma after January 1, 1899. In 6 States applicants must have a competent preliminary education, though the provision is indefinite except in the New York law. The laws in 13 States and 3 Territories demand either approval of medical diploma or examination by State or other duly qualified boards. This leaves only New Hampshire, in which not even registration is required, and 8 States and 3 Territories in which it is necessary merely to present the diploma or other certificate of qualification to unqualified local officers. Of the 12 medical schools in New York State, 4 adopted a 4-year graded course in 1894 and 5 in 1895 and 1896. For matriculants after January 1, 1898, four years study of at least nine months each, including four satisfactory courses of at least six months each in four different calendar years must be required for degrees by all medical schools in New York State. This minimum standard for the degrees of M. D. is equal to that prescribed in Austro-Hungary, France and Germany.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Woman's Educational Association of Boston proposes to institute scholarships in summer schools for Boston school teachers, and urges women's clubs and other organizations of women interested in public-school work to establish similar scholarships, or to select at least one of their young teachers who shall be sent to a summer course. A list of eight of the chief colleges and universities offering such courses is added. During the summer of 1896 the scholarships of the Boston Association will be chiefly offered for the course in physical geography at Harvard University. The amount of money now at the disposal of the Association being small, the committee asks that contributions toward this object be sent to Mrs. R. H. Richards, Institute of Technology, Boston.

THE board of regents of the University of Wisconsin has recently made the following promotions in the faculty of that institution: Louis W. Austin, Ph. D., from instructor in physics to assistant professor in physics; Lellen S. Cheney, B. S., from instructor in general and pharmaceutical botany to assistant professor of pharmaceutical botany; Wm. S. Marshall, Ph. D., from instructor in biology to assistant professor of zoölogy; Wm. A. Scott, Ph. D., from associate professor of political economy to professor of economic history and theory. Frank C. Sharp, Ph. D., from instructor in philosophy to assistant professor of philosophy; Rodney H. True, Ph. D., from instructor in pharmacognosy to assistant professor of pharmacognosy.

THE Connecticut Dental Association has voted to petition the Yale corporation for the establishment of a dental school at Yale University.

DR. ROBERT G. REMSEN, JR., of the Class of '73, has given the New York University $3,000 toward the endowment of scholarships.

THE University of Glasgow has received £8,000 by the will of the late Dr. John Grieve, the money to be used for the foundation of a lectureship or fellowship.

THE following foreign appointments are announced: Dr. Ludwig Katheriner, professor of zoölogy and comparative anatomy in Freiburg, Switzerland; Mr. James G. Lawn, professor of mining at the South African School of Mines, Cape Town and Dr. Otto Fischer, associate professor of physiological physics at Leipzig.

DISCUSSION AND CORRESPONDENCE.

A REVIEW OF BIGELOW'S PAPERS ON METEOROLOGY AND SOLAR PHYSICS.

ABOUT a year ago the writer was so struck upon reading a paper* on the 'Inversion of Temperatures in the 26.28 Day Solar Magnetic Period' that he was led to look a second time at a previous paper by the same author, viz., a 'Report on the Relations of Solar Magnetism to Terrestrial Magnetism and Meteorology.'† A severe estimate of these papers induced the writer to study carefully such others ‡ of Prof. Bigelow's papers as have been accessible. The result is that the writer has reached a trenchant conviction that Prof. Bigelow's theories are peculiarly and wildly vagarious and that his results are meaningless. A more recent paper §

* By Frank H. Bigelow, Professor of Meteorology, U. S. Weather Bureau. Am. Jour. Sci. (3),48, p. 435.

† Report for 1891–2 of the Chief of the U. S. Weather Bureau, p. 519.

‡ *Notes on a new method for the discussion of magnetic observations.* By FRANK H. BIGELOW. Bulletin No. 2, U. S. Weather Bureau.

The polar radiation from the sun. By FRANK H. BIGELOW. Astron. and Astro-Physics. 13. p. 26.

The two magnetic fields surrounding the sun. By By FRANK H. BIGELOW. Astron. and Astro-Physics. October, 1893.

Further study of the corona. By FRANK H. BIGELOW. Am. Jour. Sci. 3, 40. p. 343.

The Solar corona, an instance of the Newtonian potential function in the case of repulsion. By FRANK H. BIGELOW. Am. Jour. Sci. 3, 42. p. 1.

Note on the causes of the variations of the magnetic needle. By FRANK H. BIGELOW. Am. Jour. Sci. 3, 42. p. 253.

The solar corona discussed by spherical harmonics. By FRANK H. BIGELOW. Smithsonian Institution, 1889.

Bulletin No. 18, of the U. S. Scientific Expedition to West Africa, May, 1890.

§ *The Earth as a magnetic shell.* By FRANK H. BIGELOW. Am. Jour. Sci. 3, 50. p. 81.

proves, upon examination, to be, again, mere iterate nonsense.

The writer is old-fashioned enough to believe that a plain person can, with some pains at least, understand the writing even of a specialist, and he is driven by a sense of sheer outrage to criticise these writings of Prof. Bigelow; not, indeed, without peculiar hesitation, for to criticise is to point out fallacy, but there is nothing such in these papers; they are too inane to be fallacious! Let the reader bear in mind that the writer's estimate of these papers has been reached only after studious and repeated reading of more than one hundred thousand such words as are sampled in the following quotations.

Speaking of the previous efforts in systematic meteorology Prof. Bigelow says: "The best efforts have been made along the lines of Thermodynamics as the moving cause and dynamical mechanics as the procession of effects; much talent, if not genius, having been expended on these mathematical and physical relations."*

Prof. Bigelow has devised a method for determining the synodic period of rotation of the sun. This method, so far as the writer can understand it, is Gauss's well-known method, in which a time interval is determined during which an unknown whole number and a known fraction of periods have elapsed; the whole number is found by dividing the interval by a known approximate value of the period; the exact period is then easily calculated. To obtain the data for this determination Prof. Bigelow claims definitely † to have made use of the aspects of the solar corona as photographed during several total eclipses, the corona being assumed to rotate with the sun and to present persistent peculiarities of form.

He goes on to say: "It is impossible to reproduce fully the process of obtaining this period, because the work is extensive; but it is so important, being the key to my development of the subject, that I will briefly indicate the method. If the sun is a magnetic sphere in which the magnetism is distributed with irregular intensity throughout the mass, in the same way that the permanent magnetism of the earth deviates from the simple law of the uniform spherical magnet, then in the field outside the sun, as far as its strength reaches into space, the lines of force being propagated through the ether, these variations of intensity will be found by an observer passing along it from point to point."* He adds that if this field reaches the earth it will change as the sun rotates and can be 'measured with almost incredible accuracy;' but we gain no clue to the method which must be some other than Gauss's method, after all, unless indeed the terrestrial magnetic elements have such a distinct fluctuation in the solar-rotation period as to enable an observer to infer the recurrence of solar rotations thereby, which Prof. Bigelow does not state explicitly; but the 26-day variation of the terrestrial magnetic elements is only brought out by averaging magnetic data at corresponding epochs in a large number of successive solar-rotation periods, and then only with great uncertainty. Prof. Bigelow does not seem to bear it clearly in mind that he has used the corona in determining this period.

Prof. Bigelow imagines three cosmical magnetic fields at the earth, viz: the 'coronal field,' perpendicular to the ecliptic due to the action of the sun as a great magnet; the 'radiant field,' in the direction of the sun's rays, and the 'orbital field,' in the direction of the earth's motion in its orbit. Speaking of the coronal field Prof. Bigelow says: "This field enters the northern hemisphere nearly parallel to the earth's axis of rotation, having been diverted from the direction perpendicular to the plane of the ecliptic by the rotation of the earth on its axis, the other component having been screened off or used up in connection with the earth's permanent magnetism, which may be the true origin of the force which gives it a slow secular variation.† At this place we interpose the remark that the position is regarded as proven that the sun and the moon do not continuously

* Report for 1891–2 of the Chief of the U. S. Weather Bureau, p. 519.

† See p. 521 report for 1891–2 of the Chief of the U. S. Weather Bureau.

* Report for 1892–2 of the Chief of the U. S. Weather Bureau, p. 521.

† Report for 1891–92, of the Chief of the U. S. Weather Bureau, p. 522.

influence the terrestrial field by direct action as magnets."*

The coronal field *is* referred by Prof. Bigelow to the action of the sun as a great magnet; at least, while convincing himself of its existence in his earlier papers, he assumes it to be due to this action; but after reaching this conviction he appears to think it no longer necessary for the field to have a physical cause.

"The solar magnetic field represents a type of radiant energy, probably circular or spiral rotation of the ether which surrounds the sun on all sides, but of variable strength in certain solar longitudes. In other words, the earth passes through a series of hotter and cooler regions as the sun turns on its axis. One day is the equivalent of about 10,000,000 miles. Since the form of energy is magnetic, which, of course, means a special form of ether motion, this energy approaching the earth, itself a magnetic body capable of conducting the lines of force better in some directions than in others, is concentrated or focussed in the magnetic ovals surrounding the magnetic and geographical poles. The form of the regions of concentration came out fully in my study of the equatorial radiant field. Thus the atmosphere around the polar regions is intermittently heated or cooled, according as more or less of this polar energy falls upon it, the temperature being a direct function of the radiant energy."†

The idea that vortex motion of the ether constitutes magnetic field is, as yet, mere speculative theory‡ intensely interesting, coming from such masters as Lord Kelvin and Clerk Maxwell; supremely foolish, coming from one who, for example, uses the word 'spiral' in speaking of it, or from one who thinks a magnetic field to be a stream of energy!

"As already described, besides the coronal field perpendicular to the plane of the ecliptic near the earth, there is another field, in the plane of the ecliptic, called the radiant field, agreeing with the direction of the ether energy of light and heat emitted from the sun. It originates in the electric discharges between the atoms of the photosphere, is electro-magnetic, is propagated with the velocity of light, and in the atmosphere of the earth and in the earth itself undergoes a complex series of transformations of energy, by which the short, rapid waves are lengthened or destroyed, the work thus used up appearing in transformations of physical phenomena."*

"The finally constructed field surrounding the earth is exceedingly complex, and a description of it here is quite impossible, though some of the leading features of it may be mentioned. The fundamental law of the entry and departure of the forces from the earth conforms to the tangent law of magnetic refraction, the index being about 1.25. In the northern hemisphere the field (Radiant Field) points towards the sun, in the southern away from the sun, so that the earth is in a magnetic couple, the radiant field showing a potential fall from the sun outwards. The plane of symmetry of the field is not on the meridian of the sun, but is thrown westward by the rotation of the earth, through an angle of about 23° in the northern and 15° in the southern hemisphere. The field shows a series of five parts, gradually changing within their areas, but discontinuous as to each other. These are the polar field, the north midlatitude field, the equatorial field, the south midlatitude field, and the south polar field. The polar field is three or four times as strong as the others, in which the forces concentrate in two polar points and act along the meridians; the northern field points across the meridians, the discontinuity being along the belt of the auroral maximum of frequency; the equatorial field points north or south, and the southern field across the meridians, away from the sun. The strength of the radiant field is about 0.000135 c. g. s., being a little greater than the coronal field. A complete discussion of the numerous physical problems arising from these facts cannot now be attempted, but great light is thrown upon many of the observed physical phenomena that have been perplexing to scientific research. It seems especially to confirm in a marked degree the theory of Maxwell regarding the electro-magnetic constitution of the radiant ether waves."† "The surprising identification of magnetic and light action of the radiations of the sun in direction will be recognized as harmonizing with the conclusions arrived at by Maxwell and Hertz in their investigations."‡

Now, the magnetic field in light and heat waves is at right angles to the ray and is reversed in *direction* millions of millions of times per second! It is to be noticed that Prof. Bige-

* Bulletin No. 2, U. S. Weather Bureau, pp. 7–8.

† Astron. and Astro-Phys., 13, p. 37.

‡ Compare Prof. Oliver Lodge, London Electrician, Jan. 18, 1895, p. 332.

* Report for 1891–92, of Chief of Weather Bureau, p. 254.

† Report for 1891–92, of the Chief of the Weather Bureau, pp. 524–525.

‡ This is verbatim quotation. The reference has been lost among the mass of the writer's notes, and cannot be recovered with reasonable labor.

low considers the 'coronal' field to be a stream of energy. If such is the case it is of course not a magnetic field, but he surely so considers it and has determined its strength C. G. S! as he has also determined the strength of the 'Radiant' field and of the 'Orbital' field!

Forgetting the essential character of his corona Prof. Bigelow, in a recent paper,* 'adopting J. J. Thomson's language,' scrambles wildly after a conception of the sun's corona as a stream of matter.

"It should be noticed that there may be found in this polar radiation the true cause of the great changes of temperature in the polar regions, known in the glacial epoch." † "It is hoped that the developments of the case may not lead to any permanent difficulties that cannot be overcome, for the following reason: In a final analysis it appears that all these phenomena are to be referred to Newton's Law." ‡

The passages here quoted from Prof. Bigelow's papers do not suffer by extraction from the context. Very few passages are specific enough to be quoted to any purpose whatever, and it is this fact which has governed the present choice. The paragraph referring to 'a diagram of magnetic centers,' page 523 of the Report for 1881–2 of the Chief of the United States Weather Bureau, is a fair sample of the involved vacancy of Prof. Bigelow's style. Yet curiously enough, *being entirely devoid of conceptions*, it at first strikes one merely as something one does not understand.

"In two papers § already published, a brief statement has been presented of the lines of evidence that tend to prove the following facts: 1. That the sun emits two distinct types of radiant energy into the space outside of its surface. 2. That the first is propagated radially in all directions, the part falling upon the earth, especially on its equatorial belt, being an electro-magnetic wave, whose electro-motive force

$$\int (Xu + Yv + Zw)d\tau, \|$$

by the law of the conservation of energy, breaks up into the dynamic wave

$$\int \left(u\frac{dF}{dt} + v\frac{dG}{dt} + w\frac{dH}{dt} \right) d\tau$$

partly inductive and partly magnetic in its instantaneous state, plus the static or potential stress.

$$\int \left(u\frac{d\psi}{dx} + v\frac{d\psi}{dy} + w\frac{d\psi}{dz} \right) d\tau$$

plus the irreversible energy of Joules' (*sic.*) heat

$$\int \frac{u^2 + v^2 + w^2}{C}\, d\tau \text{ ''*}$$

The mathematical discussion in this paper (Astron. and Astro-Phys. 13, p. 26) begins and ends with this quotation. It is in no way a conclusion to anything gone before, nor the beginning of anything to be finished afterwards. As to what it really is, the writer's opinion is already sufficiently expressed. Those who can recognize the bricks in it will have no difficulty in judging for themselves. A passage of the same character occurs pp. 95–96, Vol. 50, Am. Jour. Sci.:

"The real order of events in Nature may, however, be summarized as follows: The Equatorial Field generates a tropical high pressure, and a sub-polar low pressure belt, by its distribution of temperature. The continents rearrange these belts so that in winter the small polar circuit surrounding the Icelandic permanent low supersedes and predominates, while in summer the great midlatitude circuit regains its supremacy. Therefore in winter the circulation of the polar circuit is more rapid; being smaller in diameter, the supply comes across the North American polar regions, and but little from the Pacific; in summer the slower eastward march in the wider circuit sets in, with the supply from the Pacific. In both cases the movement of the air masses is dominated by the varying intensities of the polar magnetic field from the sun, by which the densities of the contents of the unit volume is changed. High pressure areas are the primary products of these sources of energy, being in part whirled up by the general circulation, and in part the result of reducing the polar absorption by diminution of the cosmical energy on certain dates.†

This is not so distinctly articulate nonsense, by far, as are the more theoretical parts of Prof. Bigelow's papers, for there *is* such a thing

* See Am. Jour. Sci., 3, 50, p. 83.

† Astron. and Astro-Phys., 13, p. 39.

‡ Bulletin No. 2, U. S. Weather Bureau, p. 9.

§ American Meteorological Journal, Sept., 1893, Astron. and Astro-Phys., Oct., 1893 (Prof. Bigelow's Reference).

‖ No reference whatever to the significance of the symbols nor to the source of the expressions.

*Astron. and Astro-Phys. 13, p. 26.

† Am. Jour. Sci., 348, p. 449.

as a high or a low pressure area, such a place as the North American polar region and a Pacific Ocean.

The reader will find sets of curves* showing such coincidences as Prof. Bigelow thinks to have discovered between certain periodic phenomena of terrestrial magnetism and certain periodic meteorological phenomena. The writer is unable to give any definite help towards a clear understanding of these curves, indeed, "A complete exposition of the data is impossible in this connection, and therefore no values are assigned to the ordinates of the several curves."†

In conclusion, let it be said that the writer has had occasion to examine irrational writing before, but he has never encountered such froth till now. The more excusable nonsense, and often the more evident, is that which is built, it may be with care, upon false conceptions; but these papers of Prof. Bigelow's are devoid of all conceptions, and at best they are mere pretension.

The writer begs the reader's indulgence in what may seem to be undue severity in this, to the writer, questionable business; but having been vexed with it for more than a year, between the difficulty of bringing it to an end, on the one hand, and the impossibility of putting it aside, on the other, he is now chiefly anxious to be done with it, and is inclined to give, with a minimum of argument and example, the plainest and sternest statement of fact.

W. S. FRANKLIN.

IOWA STATE COLLEGE.

* Report for 1891–2, of the Chief of the Weather Bureau, plate IV., Am. Jour. Sci., 3, 48, p. 448.

† Report for 1891–92, of Chief of the Weather Bureau, p. 525.

DR. BRINTON ON KEANE'S 'ETHNOLOGY.'

TO THE EDITOR OF SCIENCE: In SCIENCE, March 20th, Dr. Brinton has a notice of my *Ethnology*, which is so manifestly unfair that I will ask you to allow me a little space for a brief reply. The 'title is an error,' because I take ethnology to be 'nearly synonymous with anthropology as employed in modern science.' On the contrary, I carefully distinguish between *general* anthropology, which, of course, covers 'all branches of knowledge whose subject is man,' and *special* anthropology, to which ethnology is 'complimentary' (pp. 1-2). Dr. Brinton does not call attention to these distinctions, thus leaving himself convenient scope to quibble and misrepresent.

My theory of races 'is a modern recast of that of Blumenbach.' Not so; on this point I reject Blumenbach and state in the clearest language that 'Linné's original fourfold division must be upheld' (p. 222). Blumenbach's Malayan race is 'explained away as partly Ethiopic, partly Caucasic." Rejecting Blumenbach's five divisions, I had no occasion to 'explain away' his 'Malayan race.' Nor do I represent this race as 'partly Ethiopic, partly Caucasic,' but 'distinctly Mongoloid, one might almost say Mongolic without reservation' (330).

I refer to opponents as 'eccentric or reckless or extravagant.' These epithets are used sparingly and never personally, but only in reference to strange or impossible theories, such as: 'evolution with a jump' (p. 235), and the like.

I 'do not hesitate to strain a point to defend his [my] opinion,' and Virchow on the Neanderthal skull is given as a proof. Here the point is strained, not by me, but by Dr. Brinton, who omits Virchow's last word on the subject, which is that he never maintained 'the *absolutely* pathological character of the skull' (p. 424). This, no doubt, leaves Dr. Brinton *im Stiche*, but that is no reason why he should bring false charges against me.

I claim 'as original' to myself, amongst other theories, 'the relationship of Basques and Berbers.' No! what I claim as original is my 'general treatment of * * * the Ibero-Berber question' (xv.), which Dr. Brinton knows is quite a different thing.

"The relationship of the members of the various races is shown by 'family trees,' an ancient and misleading device." These trees are not 'ancient;' they are mine; or will Dr. Brinton tell us where else he has seen them? But they are 'necessarily misleading;' yes, if the accompanying text be overlooked, and the branches wilfully entangled, and then notes of exclamation added as thus: "The Teutons and Slavs are on a different branch!" The Teutons and

Slavs are on *two* different branches!! Again, "The Kolosch and Selish are depicted as proceeding from the Eskimo!" I write Kolush*an* Salish*an*, plainly showing, as explained in the text (p. 360) that I mean these to be taken as *stocks* (not secondary groups), in accordance with Mr. Powell's 'convenient plan.' But Dr. Brinton suppresses the final *an* and is thus able to hold me up to ridicule by the long discredited *suppressio-veri-et-suggestio-falsi* argument.

"The chapter on the American race is replete with positive assertions, nearly always unsupported; for instance, 'the alleged impassiveness of the native character.'" Well, I devote five pages (353–357) to that subject, and support my contention by the authority of Pastor Egede, Reclus, Catlin, J. P. Dunn, Jr., Humboldt, E. F. Knight, E. im Thurn and Darwin!! So it is Dr. Brinton's charge that is 'unsupported.'

I refer to 'a highly respected American writer, as Mr. Thomas Cyrus (p. 370).' Yes, but Dr. Brinton forgot to tell his readers that this was the merest slip, as clearly shown by the correct references to that excellent authority at p. 107, p. 343 and in the index.

But "it is obvious that the author has not consulted the best and most recent studies in American aboriginal ethnography." How can this be when Dr. Brinton tells another circle of readers (Dr. Brinton spreads himself considerably) that my work is "scarcely more than an expansion of the one referred to, pursuing the same plan, treating the same subjects in nearly the same order, and in various portions advancing as his own the opinions set forth by that referred to, to wit: 'Races and Peoples, Lectures on the Science of Ethnography, by D. G. Brinton, New York, 1890' (*American Anthropologist*, March, 1896, p. 100). If, I say, my ethnology is scarcely more than an expansion of a book by Dr. Brinton, how can he now truthfully say that I have 'not consulted the best, etc.,' on the subject? Or has the sage of Philadelphia such a poor opinion of his own compilations as to regard them as 'the worst, etc?' I may incidentally add that this disgraceful charge of wholesale plagiarism is as baseless as all of Dr. Brinton's other charges. His *Races and Peoples* was never once consulted by me on any single point, and at the present moment I have but the haziest recollection of its contents, even giving it an incorrect title in the reference made to it from a treacherous memory in the preface, p. vii.

Dr. Brinton again refers to my 'theory of the Malayan race,' which should be my theory of the 'Interoceanic Races,' of which the Malayan is but one. This theory, he writes, "we may allow is at present, and is likely to be his [my] own peculiar property." This is hitting me below the belt with a vengeance, for Dr. Brinton, who knows everything, knows quite well that the theory in question, first brought by me before the British Association in 1879, has since been accepted in its essential features both by Dr. Hamy and de Quatrefages, two of the most distinguished French anthropologists of our times.

Dr. Brinton, however, is gracious enough to make one concession. He is willing to allow that one particular chapter 'might have been much more uninstructive.' To be sure, this may be 'meant sarcastic,' or may even be regarded by some as a choice specimen of concentrated malevolence. In any case, it is not much for a book which I am able to inform Dr. Brinton has been received with acclamation in England, which has been spoken well of in the far West (*American Journal of Sociology*, Chicago, March, 1896), and which has been accepted on the continent as *le meilleur traité d ethnologie que nous possédions jus qu'à présent* (*Rev. Bibliographie*, Feb., 1896, p. 100).

With this I may confidently leave 'this fellow here with envious carping tongue' (Shakespeare) to the judgment of your American readers. A. H. Keane.

Arám Gáh, 79 Broadhurst Gardens,
London, N. W., April 22, 1896.

I closed my notice in the *American Anthropologist* of Mr. Keane's work with an expression of regret at the discourteous language he uses toward those with whom he disagrees. If other evidence were lacking to prove the justice of my remark, it would be supplied by the above letter. So abusive was that sent by Mr. Keane to the *Anthropologist*, in reference to my notice, that the editor felt constrained to omit some of its adjectives, and supply their position by blank spaces!

In the *Anthropologist* I asserted that in his so-called 'Ethnology' Mr. Keane 'pursues the same plan, treating the same subjects in nearly the same order' as I did in my 'Races and Peoples,' published six years ago. Mr. Keane now professes to have 'but the haziest recollection' of the contents of that book (though in his note in the *Anthropologist* he acknowledges to have read it). Its very title he had quite forgotten! His 'treacherous memory' led him to mention it under quite a different name from the one it bears! How, then, 'can he truthfully say' (to quote his words) that the scheme of his book has *not* the singular similarity I noted to that of my own? He is convicted out of his own mouth of denying the charge I made, without pretending to ascertain whether it is true! I challenge comparison of the books by readers not disabled by a morbid self-esteem from deciding correctly. I challenge the production of any other work on this science, published in any language, since 1889, so obviously akin in plan and treatment to my 'Races and Peoples,' as is Keane's 'Ethnology.' I am quite willing to allow Mr. Keane the plea of 'unconscious memory;' but the facts speak for themselves.

Mr. Keane makes the assertion that I brought a 'false charge' against him in reference to Virchow's opinion about the Neanderthal skull. He quoted Virchow as stating that the skull was 'possibly pathological.' I quoted Virchow's own words, giving them in the original German, that he had offered 'the positive proof' that it was pathological. The 'false' statement is unquestionably Mr. Keane's; but then he suffers from such a 'treacherous memory!'

Mr. Keane seems much disturbed at my statement that he had not consulted the best and most recent studies on American aboriginal ethnography. In reply, he makes no pretence that he did so, but follows the legal precept, 'When you have no defence, abuse the opposite counsel.' I turn to his index and look in vain for the names of Adam, Bandelier, Ehrenreich, Leon, Middendorf, Quevedo, Seler, Steinen and many others, without a knowledge of whose excellent labors it is presumptuous in a writer to pretend to any but a second-hand and superficial knowledge of American ethnography.

It is needless to occupy more space with such a discussion. I reiterate the justice of my criticisms on Mr. Keane's book; and as a set off to his report of the 'acclamation' with which, he informs us, it has been accepted in England, I add that I have received letters from several prominent anthropologists in the United States telling me that I had dealt with its errors and crudities much too leniently.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

TO PREVENT THE GROWTH OF BEARD.

IN March last, Dr. B. F. Egeling, of Monterey, Mexico, sent to the Department of Agriculture several specimens of the cocoons of a large Bombycid moth, with the statement that these cocoons are worn by the natives around the neck and are believed to prevent the growth of beard on the chin. Dr. Egeling wished to know the name of the species. Specific determination was impossible from the cocoons alone, but on May 18th a fine female specimen of one of the handsomest of the Central American Attacine moths issued and proved to be *Attacus jorella*, of Westwood, described in the Proceedings of the Zoölogical Society of London, 1853, pp. 150–160, and figured at Plate XXXII., Fig. 1. The locality given by Westwood is Cuantla, Mexico, and the statement is made that the type specimens were reared in August from cocoons spun the previous October. The use to which the cocoons are said to be put by the natives is new to the writer. Perhaps it has been recorded by some collector of facts of this nature.

L. O. HOWARD.

THE CHILD AND CHILDHOOD IN FOLK-THOUGHT.

TO THE EDITOR OF SCIENCE: The author of 'The Child and Childhood in Folk-thought' has no desire to enter the lists on behalf of his book, being willing to have its fate decided by those to whom it has appealed and for whom it was written. But against the general dogmatic tone of the reviewer (SCIENCE, N. S. Vol. III., No. 72) he ventures a mild protest. Hardly does the present state of the science justify the cocksureness there displayed, nor is the reviewer vindicated in his certainty that the author intended to force a 'psychological connection' here, or ought to have made out one there. If Dr. Boas, remembering that all writers have not reached that eminence of synthesis and systematization on which he so conspicuously dwells, will once more peruse the the volume he will discover that neither in its claims nor in its execution does it traverse those sound principles of the comparative method of which a peculiar interpretation belongs to him. In these the writer believes as thoroughly as does the reviewer. But, as to the exact manner and method of determining where a 'psychological connection' exists, or what phenomena are 'derived psychologically or historically from common causes,' a great deal of reasonable difference in opinion exists, and this the author has not ignored. The reviewer has throughout attributed to the writer a much more ambitious thesis than he really attempted, and has apparently seen efforts at connection and comparison where none such existed or were thought of. That the author has completed the task he set himself, other reviewers have perceived and acknowledged; to have accomplished the task the reviewer sets him, he had needs be the reviewer himself.

Alex. F. Chamberlain.

Worcester, Mass., May 15, 1896.

'THAT GREAT LAW OF LOGIC.'

In a recent number of this Journal (p. 668 above) I ventured to criticise Professor Brooks for using ambiguously the phrase 'test of truth,' and for not appreciating the force of a letter by M. M., calling attention to this. I then pointed out what seemed to me an analogous confusion in regard to the material and the efficient causes of evolution, saying that I did this at the risk of being accused of irrelevancy by Professor Brooks. I did not at all intend to include Professor Brooks with those who have confused material and efficient causes, and his reply (p. 779 above) should have been directed to Professor Cunningham who in the May number of *Natural Science* makes, I think incorrectly, this charge.

Professor Brooks is mistaken in saying that I did not specify anyone who seems to me to use the word 'cause' ambiguously. It is, indeed, easy to adduce other eminent naturalists in addition to the one to whom I referred. Thus Professor Weismann writes in his most recent paper (*On Germinal Selection*, authorized translation: Chicago, 1896): "The protective coloring * * * * arose not because it was a constitutional necessity of the animal's organism that here a red and there a white, black, or yellow spot should be produced, but because it was advantageous, because it was necessary for the animal." Weismann's state of mind seems to be similar to that of the little boy who was watching at a hole for a woodchuck to come out, and when asked how he knew there was a woodchuck in the hole said "because we have company for dinner and there is no meat in the house."

While Professor Brooks replies to a question in which we agree he neither defends nor retracts the statement which I think is guilty of an analogous blunder, and it seems as though he does not appreciate the point raised by M. M. It is, perhaps, merely a matter of words, but when words are used ambiguously arguments become fallacious. When Professor Brooks writes advocating "that great law of logic, '*the test of truth is evidence and not conceivability*,'" does he mean to deny that conceivability is a sufficient proof of truth or to deny that conceivability is a necessary condition of truth, and what does he mean by conceivability?

In the curious history of thought we have had inconceivability urged as a proof of truth, but not, so far as I am aware, conceivability; no one holds that the situations in the modern realistic novel have occurred because they are conceivable. It has, however, been claimed that conceivability is a necessary condition of truth, and by one who holds this position (as Mr. Herbert Spencer) Professor Brooks' statement could neither be affirmed nor denied any more than he could answer yes or no to the question "Did you hold the lantern when your father robbed the stagecoach?"

Then Professor Brooks' 'great law of logic' is doubly illogical because he also uses the word 'conceivability' ambiguously. When he writes that he 'cannot conceive of the antipodes' he uses the word differently from Huxley in the sentences he quotes, for Huxley only says that he believes that something will be accomplished, though he cannot conceive how. It happens that J. S. Mill uses Professor Brooks' example to explain the proper use of the word, writing (*Logic*, II., p. 321): "Antipodes were really, not ficticiously, inconceivable to our ancestors: they are, indeed, conceivable to us." Everyone will agree that conceivability in Professor Brooks' sense is not a necessary condition of truth, but this does not concern his subsequent argument.

Professor Brooks states in his last letter that Aristotle held "that our business in this world is to learn all we can of the *order* of nature, leaving to more lofty minds the attempt to find out what it is that 'produces anything and makes it what it is.'" Yet very curiously in his previous article to which he refers (SCIENCE N. S., Vol. I., p. 126) he wrote: "I should like to see hung on the walls of every laboratory * * * the older teaching of the Father of Zoölogy [Aristotle] that the essence of a living thing is not what it is made of, nor what it does, but why it does it." Professor Brooks seems to have proceeded from the *ignoramus* of his preceding paper to *ignorabimus* now, but he is not justified in taking Aristotle with him.

J. MCKEEN CATTELL.

COLUMBIA UNIVERSITY.

SCIENTIFIC LITERATURE.

A Text-book of Gas Manufacture for Students: By JOHN HORNBY, F. S. C. 12mo, pp. 261; 6 plates. London, 1896, Bell & Sons. New York, Macmillan & Co., 66 Fifth Ave. $1.50.

A concise little book setting forth the chief points in gas manufacture in a manner that students can readily grasp has been a desideratum. The manufacture of coal gas, with its attendant by-products, is very extensively developed in England; hence to that country we look for excellent treatises on this subject, and this 'Text-book' meets the requirements.

After a short consideration of the properties and value of various coals for gas making, the author discusses carbonization; the construction and setting of retorts and furnaces; the various appliances usually found in the retort house; the effect of temperature on the quantity and quality of the gas and on the by-products; condensation of tar; removal of ammonia and the elimination of other impurities; methods of testing purity and illuminating power; the various problems incidental to the distribution of gas to the consumers, and the construction of meters and burners. In Chap. XX., on the Composition of Coal Gas, is shown the effect of the various components of gas on its illuminating power.

The American reader will notice the slight attention given to water gas. Very little of this is used in England, it having been developed within the last fifteen years, while in most cases the English coal-gas works, with their plants for saving by-products, have been established much longer. A short description of the Lowe process, together with a plate, is given.

The author divides the water-gas process into 'continuous,' in which the reaction between carbon and steam takes place in an externally heated retort, and 'intermittent,' in which the carbon is raised to incandescence by an air blast, and then steam is blown into the hot mass. He adds that the continuous process has not proved a success. But in this country the term 'continuous' is applied to those processes in which a non-luminous water gas is made in a generator and stored in a gasometer, being afterwards carburetted in externally heated retorts. Processes of this character, notably that of Wilkinson, have proved very successful here for large works.

A short description of Peeble's gas-enriching process is followed by a chapter on sulphate of ammonia, which closes the book.

The print and plates are excellent and the illustrations are generally good, excepting two indistinct views of mechanical charging and drawing apparatus. FRANK H. THORP.

Repetitorium der Chemie: DR. CARL ARNOLD, Professor der Chemie an der Köngl. Tierärzlichen Hochschule zu Hannover. Siebente Auflage, Verlag von Leopold Voss, Hamburg und Leipzig. 1896.

This octavo-volume contains six hundred and six pages, of which three hundred and forty-six are devoted to organic chemistry and the remainder to inorganic chemistry. Concise and correct statements regarding the more important data of the various elements and their derivatives are given. No fault can be found with the matter presented. One is impressed with the fact that the most recent chemical literature has been carefully gleaned. It is stated in the preface that when preparing this book the author had mainly in view the needs of medical and pharmaceutial students, and the impression made upon the reviewer, after careful examination of the text, inclines him to the opinion that Prof. Arnold has truly succeeded in making a valuable 'quiz compend' for a class of students who study chemistry chiefly as a side issue. The typography and binding are well executed. S.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE June number opens with an article by M. Carey Lea, 'On the Color Relations of Atoms, Ions and Molecules.' This is the second part of an investigation, the earlier results of which were published in the *Journal* for May, 1895. In the present paper the author discusses first the interaction of ions. It is shown that if a colored substance be formed by the union of a colorless kation with a colorless anion, the color belongs to the molecule only. The colorless ions have so modified each other's vibration periods that selective absorption is exercised. As soon, therefore, as the molecule is divided into ions the color must disappear. Consequently a solvent which is capable of separating the ions gives a solution, which when dilute must be colorless, no matter how intense the color of the compound. This is illustrated by the case of the highly colored Sb_2S_5, which forms colorless solutions because the ions, antimony and sulphur are colorless.

Furthermore, in regard to the combination of ions, it is shown that two or more similar colorless ions may unite to form colored elementary molecules; on the other hand, if colored, they may unite to form a colorless or white molecure or polymer; or to form a molecule of a wholly different color, as when blue copper ions unite to form red copper. Still, again, two or more dissimilar colorless ions may unite to form a colored molecule, as sulphur and silver to form black silver sulphide. The use of acid indicators, for example, of litmus, is discussed, and it is shown that the change of color on contact with an alkali in no way depends upon dissociation.

The relation of the subject in general to the classification of the elements is taken up and extended beyond the point where it was carried in the earlier memoir. The failure in certain cases of Mendeléef's periodic law is remarked upon and it is shown that the relation of ions to the visual rays leads to a classification which is in complete harmony with the chemical characteristics of the elements.

C. C. Hutchins and F. C. Robinson have a paper on the making and use of Crookes tubes to be employed in studying the phenomena connected with the Röntgen rays. The authors show that, with suitable choice of material and some skill in glass-blowing, tubes of the most favorable form may be made and exhausted in the laboratory. They have repeatedly made one, exhausted it and used it, all within an hour's time. The particular form of the tube, and the shape and distribution of the electrodes which are most favorable for producing a rapid result are discussed. It is stated that excellent impressions of the bones of the hand through thin sheet zinc have been obtained in two minutes. Incidentally some suggestions are given in regard to the best method of pumping in order to produce the high degree of exhaustion called for.

A. M. Mayer gives the results of researches on the Röntgen rays. He shows, in the first place, that they cannot be polarized by being passed through herapathite, or the iodo-sulphate of quinine, discovered by Herapath. The details of the experiments leading to these results are given, and incidentally the density of the material was found to be 1.557. In studying the transmission of the rays through certain materials the following results have been obtained, taking the amount of transmission through aluminum of one-tenth of a millimeter and one millimeter respectively, as unity:

	$t=\frac{1}{10}^{\text{mm}}$.	$t=1^{\text{mm}}$.
Aluminum	1.	1.
Glass	1.016	1.180
Green tourmaline	1.016	1.180
Herapathite	1.036	1.435
Platinum	0.000696	

Finally, it is shown that the actinic effect of the Röntgen rays varies inversely as the square of the distance of the sensitive plate from the radiant source.

George I. Adams gives an extended memoir on the 'Extinct Felidæ of North America.' In this the literature of the subject is summarized; new points are added in regard to the family in general, with the description of certain typical species, particularly of *Hoplophoneus primævus*, and finally the paper closes with a new classification intended to avoid the difficulties involved in those given hitherto. The paper is accompanied by three plates.

Arnold Hague discusses the age of the Igneous rocks of the Yellowstone National Park, the study by Knowlton of the flora found in a number of localities having made it possible to arrive at definite conclusions. The author remarks that "the facts brought together here clearly demonstrate that the pouring out of igneous rocks began with the post-Laramie uplift or closely followed, and from the time of the first appearance of these rocks volcanic eruptions continued with greater or less energy throughout Tertiary time. It is evident that from the time of the post-Laramie uplift there was, as shown in the geological history of the region, a succession of events of great importance in the development of the Rocky Mountains, and that each period of this history was characterized by distinct phases of volcanic phenomena."

The occurrence of several rare species of minerals, namely, pollucite, mangano-columbite and microlite, of Rumford, Maine, is described by H. W. Foote, with analyses and crystallographic details. A. J. Moses describes a simple method of plotting the axial cross for the crystals of any species. A. W. Pierce discusses the gravimetric determination of selenium by the use of potassium iodide.

AMERICAN CHEMICAL JOURNAL, MAY.

Transformations of Parasulphamine-benzoic Acid under the influence of heat: By IRA REMSEN and A. M. MUCHENFUSS. When parasulphamine-benzoic acid is heated to 285° a remarkable change takes place, consisting of the intercharge of the amide and hydroxyl groups:

$$C_6H_4 < \begin{matrix} COOH \\ SO_2NH_2 \end{matrix} \longrightarrow C_6H_4 < \begin{matrix} CONH_2 \\ SO_2OH \end{matrix}$$

At lower temperatures other products are formed, among them being a diamide and a parasulphamine-benzoic acid different from the ordinary variety. The method of preparation and properties of these substances have been studied; but their structures are as yet unknown.

The heat of Electrolytic Dissociation of some acids: By F. L. KORTRIGHT: The author has studied the effect of difference of constitution on the heat of electrolytic dissociation and finds that certain groups produce definite thermal changes, which are however dependents on the relative position of the groups in the molecule.

On the existence of Pentaethyl Nitrogen: By A. LACHMAN. Although a number of methods were tried which it was expected would produce this substance, no evidence of its formation could be obtained.

The Conductivity of Solutions of Acetylene in water: By H. C. JONES and C. R. ALLEN. The authors show that some dissociation takes place in solutions of acetylene in water, as would be expected from its weak acid nature.

The use of Phenolphthalein in illustrating the Dissociation of Water: By H. C. JONES and C. R. ALLEN. A solution of ammonia in alcohol produces no color with phenolphthalein, as the ammonia is not dissociated by alcohol. When, however, water is added to this solution the color appears, its intensity being proportional to the amount of water added and, therefore, to the amount of dissociation caused by the water. Sodium and potassium hydroxides, however, are dissociated in alcohol and therefore produce the color in this solvent.

The action of Acid Chlorides on the Silver Salts of the Anilides: By N. L. WHEELER and B. B. BOLTWOOD. When silver formanilide is treated with benzoylchloride a diacidanilide is obtained as the final product. In the present paper it is shown that an intermediate addition product is formed, which then breaks down into silver chloride and the diacidanilide. The reaction is similar to many studied by Nef.

On the existence of two Orthophthalic Acids: By W. T. H. Howe. In this paper the cause of the difference in the melting point of orthophthalic acid as observed by a number of investigators is explained. The observations have been made probably with two different acids or mixtures of the two. Two have been isolated, which are alike in composition, molecular weight, and molecular refraction; but different in melting point, electrical conductivity, solubility, formation of salts with bases and reduction products. The author explains this case of isomerism by the difference in the arrangement of the double bonds of the Kekulé formula.

The Reduction of Permanganic Acid by Manganese Superoxide: By H. N. Morse, A. J. Hopkins and M. S. Walker. The reduction which takes place in solutions of potassium permanganate and permanganic acid is shown to be due to the action of manganese superoxide. If the solutions, after standing a short time, are thoroughly filtered, they can be kept unchanged.

This number contains also a review of recent improvements in chemical industries, with special reference to sulphur, pyrites, sulphuric, hydrochloric and nitric acids, and reviews of Ostwald's Klassiker; Review of American Chemical Research, A. A. Noyes; Organic Chemistry, R. L. Whiteley; The Chemistry of Pottery, K. Langenbeck.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, MAY 18, 1896.

The Academy met with President Stevenson in the chair.

The Section of Geology and Mineralogy at once organized.

The first paper of the evening was by Mr. Heinrich Ries entitled 'Notes of a trip through the Marble Quarries of Western New England and Eastern New York.' Mr. Ries sketched out the geology and geographic distribution of limestone quarries along the Hudson and Lake Champlain Valleys passing north and the marble quarries in the Green Mountains and Berkshire hills coming south. His remarks were copiously illustrated by the lantern and by many beautiful specimens. The paper was discussed by Messrs. Martin, Dodge and Kemp, to whose remarks the speaker replied.

The second paper of the evening was by J. F. Kemp on 'The great Quartz Vein at Lantern Hill, near Mystic, Conn.' The speaker described the vein as about 400 feet in width and at least 1,200 feet in length. Its northern extremity forms the summit of Lantern Hill about 500 feet above sea level. This portion is of hard milky white quartz. The southern extension of the vein forms Long Hill. It is lower in altitude and largely composed of loose pulverulent quartz, which, however, perfectly preserves the comby structure of the quartz vein. It consists of innumerable interlocking masses of quartz crystals. It is but slightly iron stained in a few spots. It is so soft that it can be crumbled between the fingers and is easily dug with pick and shovel without any blasting. The vein strikes north about 15 degrees east and cuts squarely across the laminations of the gneiss. It is one of the largest quartz veins known in the East and is of very pure silica. Samples from the crumbly portion range from 98 to 99.4 SiO_2. A few rare scales of some micaceous or chloritic mineral are practically the only other ones present. Under the microscope the powdered quartz appears quite fresh and exercises a vigorous influence on polarized light. Some prism faces of quartz crystals show etched figures, but in general the evidence of corroding alkaline solutions is hard to find. The speaker was therefore led to refer the pulverulent character of the vein to the effects of a faulting or crushing movement, although he inferred on the spot the action of some corroding alkaline solution, presumably magnesian. The paper was discussed by Messrs. Dodge and Hovey.

The third paper of the evening was by J. F. Kemp and was entitled 'The Pre-Cambrian Topography of the Adirondacks.' The speaker mentioned the curious outliers of Cambrian and Ordovician strata that have been discovered far up in the mountains from the main outcrops that skirt them. They lie in valleys in metamorphosed crystalline rocks, which valleys represent beyond question the old pre-Cambrian river valleys and which were filled with sediment by the encroaching sea of Cambrian and Ordovician time. Lake George is the largest example of this kind and contains remnants of Potsdam sandstone and Trenton limestone in its southern portion. The valley of Trout Brook, which lies just west of Rogers' Rock, at the north end of Lake George and that is separated from it by a high intervening ridge of gneiss, contains two outliers of Potsdam sandstone of a few acres in extent. In the valley of Putnam's Pond, in the western part of Ticonderoga township, there is another outlier of Potsdam sandstone. Both of these are shown on the map of Ticonderoga which accompanies the speaker's report to Prof. James Hall on this region, and which was published in 1895. Another isolated area of calciferous limestone is found on Schroon Lake, under Schroon Lake post office. It is a few acres in extent and the exposed rock is about 75 feet thick. It is about 350 feet above tide at its upper point. Down the lake and river valley it is nearly forty miles to the next Cambrian outcrop, which is below Hadley. The speaker also cited the little outlier of Trenton limestone near Wells, on the Sacondaga River, and the fact that the Cambrian and Ordovician sediments on the west side reach short distances into the areas of crystalline rocks and along the river valleys. He stated that all the outliers on the east side had a uniform northeasterly strike and a dip of 10 to 20 degrees to the northwest. He remarked that they occurred in the valleys of streams which are notably sluggish, explaining their slow movement by the fact that they flow in pre-Cambrian valleys, already nearly reduced to a base level. He referred their parallel strike and dip to the general warping of the surface in this region. Remarking the undoubted presence of faults in the later development of the topography he emphasized the evidence of this early erosion long before the time of fossiliferous sediments. He added that the old river valleys had in part been determined by the presence of crystalline limestones. The paper was discussed by Messrs. Dodge and Hovey.

The last paper of the evening was by L. M. Luquer and H. Ries, and described an area of Augen-gneiss near Bedford, N. Y. It was read by Mr. Luquer, and will appear in full in the Transactions .The gneiss appears to have been originally a granitic rock that has been extensively crushed and sheared out into the augen structure. The original quartz has been mostly comminuted, but the Carlsbad twins of orthoclase have remained as augen.

The paper was discussed by Dr. E. O. Hovey, who cited the case of the sheared Eisenach quartz-porphyry in which the feldspars have been crushed, but the quartzes have been drawn out.

Mr. G. F. Kunz mentioned the following items as the meeting closed :

A meteoric stone weighing 31 ounces was seen to fall by Mr. J. F. Black, April 9, 1896, at 6:15 P. M., on his farm 9 miles east and one north of Ottawa, Kansas. This meteorite contains iron particles throughout and is of the characteristic stony variety.

A remarkable nugget of native silver weighing 448 ounces troy, was lately found five miles from Globe City, Pinal county, Arizona. The mass is a water-worn nugget, slightly oval, very compact, and on its surface is bright silver-white, showing that it is made up of strings of crystallized silver, whereas the interior of the entire mass contains more or less cerargyrite. It has been presented to the Lea Collection of American Minerals of the United States National Museum.

New Zealand promises, mineralogically, to be a country of surprises, and many interesting things are gradually being brought to light by the agate hunters from Oberstein, Germany, who are visiting it. Recently they have discovered some immense masses of rolled, rutilated quartz, weighing from 10 to 30 pounds each. The masses are penetrated by crystals of rutile, red, brown and yellow, many inches in length and of the fineness of hair. Occasionally the rutiles occur very sparingly; then again they are in such profusion as to give the entire mass the appearance of being a matted mass of hair. One mass of 30 pounds was entirely of this character. A fifteen-pound mass contained a dozen or more crystals of rutile 45 cm. in length and from one-half to two mm. in diameter. Magnificent crystals of amethyst have also been found, one of which is entirely of gem-cutting material and weighs 550 pennyweights or 27½ ounces troy. Topaz, blue and white is found in the same localities.

J. F. Kemp,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The New York Section of the American Chemical Society held its usual monthly meeting in the chemical lecture room of the College of the City of New York on Friday evening, May 8th, with about fifty members present, Dr. Peter T. Austen presiding. In response to inquiries regarding the progress made by the committee appointed to canvass the matter of the organization of a chemical club, Prof. Austen stated that, in accordance with the instructions given, it had increased its numbers to fifteen and had held several meetings, to one of which the members of the New York sections of the American Chemical Society and of the Society of Chemical Industry, as well as manufacturers and gentlemen interested in the science and art of chemistry, business men and friends of chemistry were invited. The meeting was full and enthusiastic. The committee was instructed to increase its number to fifty or more and to push the organization of the club as rapidly as possible. It appears that there is not in existence in this or any foreign country any real chemical club, as differentiated from a chemical society. It is believed that the science and art of chemistry furnish so much that is characteristic that a chemical club may easily be made a unique organization.

Dr. A. R. Leeds, of Stevens Institute, read a paper on the 'Bacteria of Milk Sugar.' The author finds that the morphology, classification, physiology and botany of bacteria are so rudimentary and unsatisfactory that the most valuable methods of bacteriological investigation are still of a chemical nature, and the advances to be made in the near future are to be looked for mainly on the chemical sides of the subject.

The author was interested to note in the progress of his work that precipitated zinc hydroxide, which is generally considered amorphous or gelatinous, is really crystalline.

Dr. H. W. Wiley, of the United States Department of Agriculture in Washington, offered a paper entitled, 'Recent Advances in Milk Investigations.' It treated of the bacterial theory of milk decomposition, the composition of woman's milk as compared with cows milk and the relative value of the two for infant food, and of the commercial standards which should be fixed for the milks sent to the city markets.

Investigations of the composition of milk, in its relations to the welfare of the human race, are largely confined to the determination of its value as a nutrient. From an economic point of view, the content of fat and other food constituents is of paramount importance, while from a purely chemical point of view the most important are perhaps the composition of the different proteid bodies and the changes which they undergo, spontaneously or under the influence of bacterial life.

The author reviewed the works of Soldner regarding the proteid content of human milk, and quoted the figures given by that authority for the average composition of human milk as follows:

Proteids	1.52 per cent.
Fat	3.28 per cent.
Sugar	6.50 per cent.
Ash	0.27 per cent.
Citric acid	0.05 per cent.
Undetermined	0.78 per cent.
Total dry substance	12.40 per cent.

The undetermined substance, 0.78 per cent., are mostly nitrogenous bodies not generally found in cow's milk and for this reason cow's milk can never be so diluted or altered as to properly supply the natural nutriment of the infant.

The nitrogenous decomposition products of the blood, chief of which are urea, hypoxanthin, kreatinin, sulfocyanic acid and lecithin, are uniformly found in milk.

Mr. Marston Bogert, of Columbia University, read a paper on 'Normal Heptyl Sulphocyanid.' He offered a brief sketch of the series of alkyl sulphocyanides, giving the results of the investigations of Liebig, Lowig, Cahours, Medlock, Henry, Pelouze, Schmidt, Reimer and Upperkamp. The last work on the series was done twenty-one years ago.

Normal heptyl sulphocyanid is a colorless, mobile liquid, having a slightly alliaceous but rather pleasant odor and a specific gravity of 0.931 at 15 degrees C.

Dr. Austen exhibited an apparatus for lecture demonstration of the properties of the heavier gases.

WM. MCMURTRIE,
Secretary pro tem.

CHEMICAL SOCIETY OF WASHINGTON.

THE eighty-seventh regular meeting was held Thursday, March 12, 1896, with the President, Dr. de Schweinitz, in the chair. There were 35 members present, and Dr. Andrew Stewart was elected to membership. Mr. F. P. Dewey read a paper on 'The Refining of Lixivating Sulphides.' Dr. Dewey's paper reviewed the leaching process and the treatment of the sulphide precipitates produced. He described the sulphuric acid process of treating the sulphides, in which they are treated in strong sulphuric acid to convert the sulphides into sulphates, after which the charge is treated with water, the silver precipitated by copper and melted, and the copper sulphate crystallized.

Prof. H. W. Wiley and E. E. Ewell read a paper on 'The Determination of Lactose in Milks by Double Dilution and Polarization.' They called attention to the arbitrary correction proposed by Wiley in the determination of lactose in milk in a paper published in Vol. 6, page 289, of the *American Chemical Journal.* This arbitrary factor had been found too small, and the object of the present investigation was to eliminate it altogether, and to determine the degree of the correction to be made for the volume of the precipitate in each case by double dilution and polarization. The method was worked out carefully on whole milk, skimmed milk and cream, and it was found that the correction for the volume of the precipitate should be determined in each particular instance, as it varied from less than three cubic centimeters in skim milk to more than seventeen cubic centimeters in cream for 100 cubic centimeter flask. Citations were given to other papers in which objection was made to the optical method of determining lactose by reason of the fact that a dextrinoid body was sometimes found in milk, but the danger of error arising from this source is not great.

Prof. H. Carrington Bolton read a paper on 'Berthelot's Contributions to the History of Chemistry.' He reviewed his 'Collection des Alchimistes Grecs' (Paris, 1887; 3 Vols. 4to), and his 'La Chimie an Moyen Age' (Paris, 1893; 3 Vols. 4to), showing their scope, analyzing their contents, and indicating the important changes in chemical history resulting from Berthelot's studies. He also described briefly the character of the Greek papyri of Leyden, as well as the Arabic, Syriac and early Latin manuscripts. The origin of alchemical ideas concerning the transmutation of metals is attributed by Berthelot to attempts of Egyptian goldsmiths to make alloys which fraudulently imitated the precious metals. The Latin works said to be translated from the Arabic of Geber are shown to be fictitious, yet genuine writings of Geber are extant. The technology of the writers of the third to the twelfth century is disclosed in the volumes received.

The topic of discussion for the evening was 'Style in Chemical Books and Papers.' Dr. Wiley opened the discussion and was followed by Prof. Bolton, Prof. Seaman, Prof. Clarke, Prof. Munroe, Mr. Fireman and Dr. de Schweinitz.

A. C. PEALE,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON, 261ST MEETING, SATURDAY, MAY 2.

L. O. HOWARD exhibited a picture of three young ladies, triplets, giving statistics on the subject of triplets and stating that it was very rare for all three to reach maturity. Frederick V. Coville exhibited a ball 3½ inches in diameter, taken from the intestine of a horse. It was of a light brown color and felt-like consistency and was composed of the barbed hairs of the crimson clover, *Trifolium incarnatum.* When over-ripe crimson clover hay is fed to horses the hairs, which up to the time of flowering are soft and flexible, but afterwards become stiff and needle-like, gather into balls, sometimes becoming large enough, as in the present instance, to clog the intestine and cause death through peritonitis or some related ailment.

Erwin F. Smith exhibited a photograph made from a poured gelatine plate, showing the bactericidal effect of direct sunlight. He stated that many parasitic bacteria are killed by light and remarked on the hygienic importance of flooding sick rooms and all living rooms with sunshine. This experiment was made with *Bacillus tracheiphilus*, the exposure being only three hours. The part of the gelatine plate which was covered from the light developed from 6,000 to 12,000 small colonies in each field of the microscope, so that the gelatine became grayish white. The part of the plate which was exposed to the direct rays of the sun, a middle star-shaped portion, was easily distinguishable from the rest of the plate on the second day, and appeared throughout the experiment (8 days) to be entirely free from colonies, but a careful microscopic examination at several different times showed that about one bacillus in a thousand had escaped. These are supposed to have been partially or wholly protected from the direct action of the light by germs lying above them. With longer exposures or thinner sowings all would undoubtedly have been destroyed.

D. LeRoy Topping stated that Mr. Pollard and himself had found *Ranunculus ficaria*, at the original locality on Rock Creek, below Pierce's Mill, where it had first been noticed twelve years before.

A. F. Woods showed a tomato plant which had been exposed to hydro-cyanic acid. The stems, petioles and midribs of the leaves were killed by the gas, but the softer tissues were not injured and were able to obtain all the water they required through the dead dissue.

L. H Dewey spoke of the tumbling mustard, *Sisymbrium altissimum*, stating that it had been introduced into North America from Europe during the past 20 years, and during the past 15 years it has developed into a very troublesome weed in Assiniboia and Manitoba, N. W. Canada. It combines the productiveness and hardiness of the mustard with the distributing habit of the tumbleweed and threatens to become a most dangerous weed in the northern plains where tumbleweed and mustard thrive at their best. Prof. James Fletcher, of Ottawa, Canada, carefully estimated the number of seeds borne by a single well developed tumbling mustard at 1,500,000. This plant has been reported from nine localities in Minnesota, Iowa, Missouri and South Dakota, and from ballast ground at Philadelphia, and freight yards at Weehawken, New Jersey.

T. W. Stanton presented a communication *on the Genus Remondia Gabb*, stating that this molluscan genus from the Lower Cretaceous of Arivechi, Sonora, Mexico, which has hitherto been placed in the *Trigonidæ*, belongs to the *Crassatellidæ* and includes the later described genus *Stearnsia* White, from the Cretaceous of Texas.

B. T. Galloway read a paper on *Recent Advances in our Knowledge of the Plant Cell* briefly reviewing the early discoveries and giving in some detail the most recent contributions to the subject. A paper by C. L. Pollard on *the Purple-Flowered Stemless Violets of the Atlantic Coast* was read, in the absence of Mr. Pollard, by David White. Seven species were enumerated in addition to the Linnæan *V. pedata*, the author stating that botanists have differed remarkably in their conceptions of specific relationships in this genus; yet while there is much individual variation, the species do not intergrade to the extent usually supposed. The *Viola dentata* of Birch, *V. septemloba* of Le Conte, and *V. ovata* of Nuttall, were restored to specific rank.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 49th meeting, held on May 13th, papers were presented as follows:

The Faunal Relations of the Eocene and Upper Cretaceous on the Pacific Coast: By T. W. STANTON. The Chico-Tejon series has been described as a continuous series, showing a gradual transition both faunally and stratigraphically from the Cretaceous into the Eocene, the close faunal connection being found especially in the 'Martinez group' (an upper sub-division of the Chico), and in 'intermediate beds.' A study of the faunas and stratigraphy, especially in middle California, has proved that the intermediate beds and the upper part of the Martinez group are identical and that they form a lower zone of the Tejon, or Eocene. When the line between the two formations is thus located their faunas are but little more closely related than the Upper Cretaceous and Lower Eocene faunas of other parts of the world. With the exception of an Ammonite, of which a few specimens were reported from the Tejon in early collections, the few species that seem to be identical in the two formations are persistent types that have come down to the present day with little change.

The Structure and Age of the Cascade Range: By J. S. DILLER. The two sections of the Cascade Range afforded by the Klamath and Columbia Rivers expose volcanic rocks only and indicate that the range where most typically developed is composed essentially of lava from top to bottom. As far as yet known, it has no core of older metamorphic rocks on which the line of volcanoes developed.

He described the position and relations of the auriferous slate series.

At Ashland, in southern Oregon, the relations of the Cascade Range to the Klamaths is better exposed. They are separated by Rogue River Valley, which is cut chiefly in Cretaceous strata. Overlying these with apparent conformity, and dipping gently to the eastward beneath the Cascades are similar sedimentary rocks containing silicified wood, referred by Knowlton to a period certainly later than the Cretaceous. Above these and conformable with them on the western slope of the Cascades are numerous sheets of lava and tuff. One sheet of tuff near the base of the series contains Miocene leaves. Although the volcanic activity of the Cascade Range may have been initiated in earlier times, the period of greatest eruption and the upbuilding of the range occurred in the Neocene.

An Early Date for Glaciation in the Sierra Nevada: By WILLARD D. JOHNSON. The author described the occurrence of striated pebbles, of foreign material, in the extensive andesite-tuff flows, or volcanic mud flows of the Sierra, and gave reasons for regarding the striation of these included pebbles as probably glacial. He then called attention to a certain anomalous topography of the summit region of the range, and offered for it an interpretation which, together with the presence of the presumably glacial pebbles in the deeply canyoned lavas, appeared to warrant the inference that glaciation here had a beginning coincident with the erection of the Sierra Nevada into a high range.

W. F. MORSELL.

U. S. GEOL. SURVEY.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

May 5, 1896.—DR. F. P. HENRY made a communication on *Filaria sanguinis hominis nocturna* specimens of which had been obtained from the blood of a patient suffering from chyluria due to clogging of the lymphatics by the ova of the parasite. The various forms of the worm and their life history as given by Dr. Patrick Manson were dwelt on. The parasite secretes no toxine and its presence in man is usually not productive of bad effects. The speaker stated his belief that the excretory products of parasites are hurtful to man in proportion to the lowness of their organization. The nocturnal Filariæ appear in the superficial vessels about sunset and disappear about the time of rising. In patients induced to sleep during the day the periodicity is reversed. The only treatment is prophylactic as a drug which would kill the mature worm would, in all probability, be hurtful to the host by causing abscesses around the dead product.

Dr. Leonard, in continuation, dwelt on the morphology of the worm, illustrating his remarks by means of fine micro-photographs of the specimens described by Dr. Henry.

May 12.—DR. CHARLES S. DOLLEY described a centrifugal apparatus for the quantitative determination of the food supply of oysters and other aquatic animals which he called a Planktonokrit. By means of its use he is enabled to make a large number of plankton estimates in a day and thus judge of the characters of given areas of water in connection with fish and oyster culture at different times of the day, states of the tide, varying depths, etc.

The method employed is that of the centrifuge, an apparatus which consists of a series of geared wheels driven by hand or belt, and so arranged as to cause an upright shaft to revolve up to a speed of 8,000 revolutions per minute, corresponding to 50 revolutions per minute of the crank or pulley wheel. To this upright shaft is fastened an attachment by means of which two funnel-shaped receptacles of one litre capacity each may be secured and made to revolve with the shaft. The main portion of each of these receptacles is constructed of spun copper, tinned. When caused to revolve for one or two minutes the entire content of suspended matter in the contained water is thrown to the bottom of tubes properly placed, from which the amount may be read off by means of a graduated scale. EDW. J. NOLAN,
Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB, MAY 1.

PROF. HOUGH in the chair and thirty-eight persons present. Prof. Crew and Mr. Basquin presented the topic, 'The Identity of Light and Electricity.' "Kelvin's prediction that the discharge of the Leyden jar was (under certain conditions) oscillatory and Maxwell's equations for the propagation of electro-magnetic disturbances were derived and explained. The subject was illustrated by Faraday's experiment showing rotation of plan of polarization in a magnetic field. The nature of wave motion was shown by the Melde experiment, Kundt's tube and Weber's wave trough. The equivalence of capacity and self induction was illustrated by Lodge's experiment showing resonance between ten Leyden jars. The Lecher modification of the Hertz experiment was shown in various forms, the nodes of the electric waves being detected by vacuum tubes and bridges."

A. R. CROOK,
Secretary.

EVANSTON, ILL.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis of May 18, 1896, Professor C. M. Woodward presented a critical examination of some of the mathematical formulæ employed by Herbart to represent mental phenomena, in which these formulæ were criticised as inadequate. Though not considering any formulæ likely to be adequate, from the nature of the case, the speaker offered a substitute for the Herbart formulæ pertaining to the bringing into consciousness of a sublatent concept through the suggestion afforded by another concept similar in some respects while differing in others.

Dr. A. N. Ravold made a report on the use in St. Louis of diphtheria anti-toxine, prepared by the health department of the city. During the past winter 342 cases of diphtheria had been treated with this serum by 93 physicians. Doses of from 2.5 to 100 cc. had been administered. As a rule, the recovery was far slower when the quantity used was small than when a larger quantity was employed. Usually the serum was administered only once. In about half the cases a decided change for the better was noticeable within 24 hours, and these cases were practically cured within 48 hours, although attention was called to the fact that for some weeks the throat of a convalescent is a breeding place for the diphtheritic bacilli, the virulence of which did not seem to be diminished by the serum treatment. Of the cases reported on, 9.06 per cent. only died, and as a considerable number of cases were hopeless when treatment was administered, the patients dying within 24 hours thereafter, it was considered fair to deduct these deaths from the total, which reduced the mortality to 4.6 per cent. when the serum was administered in the earlier stages of the disease. The injurious consequences of administering the serum were fully considered, but held to be practically insignificant. It was also stated that when used on persons who had been exposed to, but had not manifested the disease, the serum proved an unfailing means of conferring immunity for a certain period of time. Among the advantages in the use of this serum was mentioned that of lessening the chances of secondary infection, so frequent after an attack of diphtheria.

A committee presented resolutions on the death of Dr. Charles O. Curtman, for many years a member of the Academy.

WM. TRELEASE,
Recording Secretary.

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CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ON THE UNTECHNICAL TERMINOLOGY OF THE SEX-RELATION IN PLANTS.

The modern conception of the sex-relation and the alternation of generations in plants has so changed our point of view respecting the morphologies of various members that an entirely new terminology has recently come into use to express the new-found homologies. At the same time, there is an attempt to restrict or to specialize the use of such age-long words as male and female, sex and the like, when applying them to plants. This part of the new terminology which touches common language is not above criticism, and I wish briefly to advert to it.

It should be said, in the first place, that the original conceptions of sexuality in plants, from Camerarius down to the middle of this century, were borrowed and adapted very largely from analogy with the animal kingdom. The stamens were considered to be male organs of sex and the pistils to be female organs, the idea of the necessity of a conformed sex-member being evidently borrowed from a knowledge of animal morphology. At the present time, however, our conception of the sex-relation of the higher plants is borrowed from a study of the flowerless plants, which, with every reason, are believed to represent a more primitive stage of evolution than the flowering plants. The true significance of the sex-process in plants was first clearly conceived by Hofmeister in 1849, when he propounded the hypothesis that certain great groups of plants undergo an alternation of generations, a sex-bearing generation being followed by a sexless generation. In certain plants, as the ferns, the sex-generation soon disappears and the sexless generation leads a wholly independent life; this sex-generation is the prothallus of the fern, and the sexless generation is the foliaceous fern-plant. But in certain other plants, as the mosses, the sexless generation remains attached to or incorporated with the sex-generation. Many of these flowerless plants produce a prothallus from the spore, and upon this prothallus are two minute unlike organs, one female in function because it develops the succeeding generation, and the other male in function because it produces the cells which fertilize the female cells. Recent morphological studies have shown that in the flowering plants the asexual generation is enormously developed and is 'the plant,' whilst the sex-generation is reduced to the minimum and is represented by a female organ developed within the ovule and a male organ developed in the pollen grain. The prothallus within the ovule encloses the germ of the asexual generation in its fertilized sexual cell, and this germ becomes the embryo of the seed; and the prothallus is absorbed, or else it remains as the albumen —or endosperm or perisperm—of the seed.

This very brief and imperfect outline is sufficient to bring the point which I have in mind before the reader, namely, how far can we use the terms 'male' and 'female,' and what must be the common language of the sex-relation in plants? Some morphologists now object to calling a stamen a male organ, or a pistil a female organ; and they base their reform upon the undisputed morphological fact that the male sex-phase of the plant is comprised within the short span and function of the generative cell developing from the pollen grain, and that the female phase is associated only with the development of the prothallus in the ovule. It should be pointed out, however, that the discovery of these morphological facts does not in the least shift the old-time attribute of maleness as applied to the stamen or of femaleness as applied to the pistil; for whether the pollen grain is sperm, as older naturalists supposed, or whether it is a spore and gives rise to a secondary generation which discharges the office of sperm, it is still all contained in the stamen; and the stamen is, in the broad sense of common language, a sexual member because its entire office is the discharge of the paternal relation. It is as much a member or organ of sex as the root is an organ of nutrition. The meaning of the sex-process has not been materially changed by the recent studies. 'Male' and 'female' never did and never can be made to express strict morphological homologies. An organ of an animal or a plant is male if it exercises the functions of paternity and not of maternity. The stamen is such an organ. Its entire office is that of maleness. The attempt to restrict the terms male and female to the ultimate sexual process seems to me to be unwarranted and hypercritical. It is interesting to observe that the morphologists fall into the very pit which they have digged, when they talk of male and female prothalli. Surely the prothallus is no more sexual than a stamen or a leaf. The egg cell and the male cell are the sexual organs, unless we choose to carry the purism to the physiological units; and since these organs soon disappear, as such, it follows that we cannot apply the terms 'male,' 'female,' 'sex,' and the like, to plants, save in the very brief period during which impregnation is taking place. This practically means that we must eliminate any reference to sexuality in all untechnical speech about plants, and the result would contribute to anything but clearness.

The common language of sex has always dealt in analogies. There are perfectly good and sufficient technical terms to designate the homologies and the ultimate physiological processes. If the hypercriticism of the plant morphologists were to be accepted for the animal creation, pandemonium would come of it. One could not speak of the members of generation as sex organs, nor of any animal as male or female. I insist that it is perfectly proper to speak of a staminate willow as male, because its ultimate function is paternity; if I cannot speak of it as a male plant, then I cannot call a bull a male animal.

L. H. BAILEY.

ON THE DIFFUSION OF METALS.*

PART I.—DIFFUSION OF MOLTEN METALS.

IN the first part of the paper the author alludes to some earlier experiments he made in 1883 on the diffusion of gold, silver and platinum in molten led. He points out that, although the action of osmotic pressure in lowering the freezing point of metals has been carefully examined, very little attention has been devoted to the measurement, or even to the consideration, of the molecular movements which enable two or more metals to form a truly homogeneous fluid mass. The absence of direct experiments on the diffusion of molten metals is probably explained by the want of a sufficiently accurate method. Ostwald had stated, moreover, with reference to the diffusion of salts, that "to make accurate experiments in diffusion is one of the most difficult problems in practical physics," and the difficulties are obviously increased when molten metals diffusing into each other take the place of salts diffusing into water.

The continuation of the research was mainly due to the interest Lord Kelvin had always taken in these experiments. The want of a ready method for the measurement of comparatively high temperatures, which led to the abandonment of the earlier work, was overcome when the author arranged his recording pyrometer, and the use of thermo-junctions in connection with this instrument rendered it possible to measure and record the temperature at which diffusion occurred. Thermo-junctions were placed in three or more positions in either a bath of fluid metal or an oven carefully kept hotter at the top than at the bottom. In the bath or oven, tubes filled with lead were placed, and in this lead, gold, or a rich alloy of gold, or of the metal under examination, was allowed to diffuse upwards against gravity. The amount of metal diffusing in a given time was ascertained by allowing the lead in the tubes to solidify; the solid metal was then cut into sections, and the amount of metal in the respective sections determined by analysis.

The movement in linear diffusion is expressed, in accordance with Fick's law, by the differential equation

$$\frac{dv}{dt} = k\frac{d^2v}{dx^2}.$$

In this equation x represents distance in the direction in which diffusion takes place; v is the degree of concentration of the diffusing metal, and t is the time; k is the diffusion constant, that is, the number which expresses the quantity of the metal in grams diffusing through unit area (1 sq. cm.) in unit time (one day) when unit difference of concentration (in grams per c. c.) is maintained between the two sides of a layer 1 cm. thick. The author's experiments have shown that metals diffuse in one another just as salts do in water, and the results were ultimately calculated by the aid of tables prepared by Stefan for the calculation of Graham's experiments on the diffusion of salts.

The necessary precautions to be observed

*Abstract of the Bakerian lecture given by Professor W. C. Roberts-Austen before the Royal Society and printed in the Proceedings of the Society.

and the corrections to be made are described at length, and the values of the diffusivity of various metals in lead are then given.

The values for k, the diffusivity, given in sq. cm. per day, are as follows:

	k	
Gold in lead	3·19 at	500°.
" " bismuth	4·52 "	"
" " tin	4·65 "	"
Silver in tin	4·14 "	"
Lead in tin	3·18 "	"
Rhodium in lead	3·04 "	"
Platinum in lead	1·69 "	490°.
Gold in lead	3·03 "	"
Gold in mercury	0·72 "	11°.

In order to afford a term of comparison, it may be stated that the diffusivity of chloride of sodium in water at 18° is 1.04.

The author at present refrains from drawing any conclusion as to the evidence which the results afford respecting the molecular constitution of metals. It is, however, evident that they will be of value in this connection, because, with the exception of the gases, they present the simplest possible case of diffusion which can occur—the diffusion of one element into another.

Thus the relatively slow rate of diffusion of platinum, as compared with gold, points to its having a more complex molecule than the latter.

PART II.—DIFFUSION OF SOLID METALS.

The second part of the paper is devoted to the consideration of the diffusion of solid metals. Much of the evidence is historical, for there has long been a prevalent belief that diffusion can take place in solids, and the practice in conducting important industrial operations supports this view. In this connection the author cites two truly venerable 'cementation' processes. The object in the first of these is the removal of silver from a solid gold-silver alloy; while the second is employed in steel-making by the carburisation of solid iron. In both of these processes, however, a gas may intervene, though the carburisation of iron by the diamond, which had been effected *in vacuo* by the author, suggests that if a gas does intervene in the latter case, its quantity must be very minute. In connection with the mobility of various elements in iron, the work of Colson, of Osmond and of Moissan is especially referred to.

The author points out that in 1820 Faraday and Stodart showed that platinum will alloy with steel at a temperature at which even the steel is not melted, and they express their interest in the formation of alloys by cementation, that is, by the union of solid metals.

The remarkable view expressed by Graham in 1863, that the "three conditions of matter (liquid, solid, gaseous) probably always exist in every liquid or solid substance, but that one predominates over the other," is shown to have afforded ground for the anticipation that metals would diffuse into each other at temperatures far below their melting points. Reference is then made to the important work by Spring in 1886 on the lead-tin alloys, which retained a certain amount of molecular activity after they had become solid, and special importance is attached to the proof afforded by Spring, that alloys may be formed either by the strong compression of the finely divided constituent metals at the ordinary temperature (1882) or (1894) by the union of solid masses of metal compressed together at temperatures which varied from 180° in the case of lead and tin to 400° in the case of copper and zinc; tin melting at 227° and zinc at 415°.

The evidence as to the volatilization of solid metals is then traced, and allusion is made to the expression of Robert Boyle's belief, that even such solid bodies as glass and gold might respectively 'have their little atmospheres and might in time lose their weight.'

Merget's experiment on the evaporation

of frozen mercury is quoted in relation to Gay-Lussac's well-known discovery that the vapors emitted by ice and water both at 0° C are of exactly equal tension.

Demarçay's experiments on the volatilization of metals *in vacuo* at comparatively low temperatures is connected with the evidence afforded by Spring (1894), that the interpenetration of the two metals at a temperature below the melting point of the more fusible of the two is preceded by volatilization.

The author then points out that, interesting as the results of the earlier experiments are, as affording evidence of molecular interpenetration, they do not, for the purpose of measuring diffusivity, come within the prevailing conditions in the ordinary diffusion of liquids, in which the diffusing substance is usually in the presence of a large excess of the solvent, a condition which has been fully maintained in the experiments on the diffusion of liquid metals described in the first part of the paper. Van't Hoff has made it highly probable that the osmotic pressure of substances existing in a *solid solution* is analogous to that in liquid solutions and obeys the same laws; and it is probable that the behavior of a solid mixture, like that of a liquid mixture, would be greatly simplified if the solid solution were very dilute.

The author proceeds to describe his own experiments on the diffusion of solid metals. They are of the same nature as in the case of fluid metals, except that the gold, which is the metal chosen for examination, was placed at the bottom of a solid cylinder of lead instead of a fluid one.

In the first series of experiments, cylinders of lead, 70 mm. long, with either gold, or a rich alloy of gold and lead at their base, were maintained at a temperature of 251° (which is 75° below the melting point of lead) for thirty-one days. At the end of this period the solid lead was cut into sections, and the amount of gold which had diffused into each of them was determined in the usual way. Other experiments follow, in which the lead was maintained at 200° and at various lower temperatures down to that of the laboratory. The following are the results:

				k.
Diffusivity of gold in	fluid	lead at	550°......	3.19
"	solid	"	251°......	0.03
"	"	"	200°......	0.007
"	"	"	165°......	0.004
"	"	"	100°......	0.00002

The experiments at the ordinary temperature are still in progress, but there is evidence that slow diffusion of gold in lead occurs at the ordinary temperature. The author points out that if clean surfaces of lead and gold are held together *in vacuo* at a temperature of only 40° for four days they will unite firmly, and can only be separated by the application of a load equal to one-third of the breaking strain of lead itself.

The author thinks it will be considered remarkable that gold placed at the bottom of a cylinder of lead, 70 mm. long (which is to all appearance solid), will have diffused to the tip in notable quantities at the end of three days. He points out that at 100° the diffusivity of gold in solid lead can be readily measured, though its diffusivity is only $\frac{1}{100000}$ of that in fluid lead at a temperature of 500°. He also states that experiments which are still in progress show that the diffusivity of solid gold in solid silver or copper at 800° is of the same order as that of gold in solid lead at 100°.

He concludes by warmly thanking Mr. A. Stansfield, B.Sc., who assisted him in all but the earlier portion of the work, and by expressing the hope that the experiments described in the paper will show that the diffusion can readily be measured in solid metals, and that they will carry one step further the work of Graham.

ON THE DETECTION OF GLACIAL STRIÆ IN REFLECTED LIGHT.

It is known that in many regions of glaciation, owing to the softness or attitude of the country, particularly in the case of schists, all traces of bed-rock striæ have seemingly been effaced by post-glacial weathering. The country about Orange, a little west of the north central part of Massachusetts, affords a good example of the case in point. The rocks are soft gneisses and hornblende schists. They strike nearly north and south and dip about vertically, or, in other words, stand on edge. Their very attitude, combined with the local variation in mineralogical composition and texture, due to the banding in the gneiss, has enabled the process of weathering to work at its maximum rate. As a result, the surface of the rock, wherever exposed, is corroded to extreme roughness, and often longitudinally pitted, so that on the rock itself about all trace of striæ has vanished. Also the approximate coincidence of direction between the striæ and the strike or banding in the gneiss renders any trace of weathered striæ which may remain not only difficult of detection, but unsatisfactory to the geologist, even when found.

There is, however, a means of determining the direction of ice-movement in this region. Happily the rocks are traversed here and there by quartz veins of moderate size. These veins being more resistant, often stand out in bold relief above the enclosing rocks now weathered down at their sides. They have retained not only their ice-polished surface, but this surface is often found to be well marked by sharply defined striæ and very fine parallel scratches, concerning whose origin the lens leaves no doubt.

These scratches sometimes occur in such delicacy as to render detection by the unaided eye difficult in ordinary light. By chance it was observed that in reflected sunlight the most delicate become readily visible, even at several yards distant. The distinctness with which the striæ are brought out is due to the marked contrast produced by difference of reflection between the unstriated part of the ice-polished surface, which strongly reflects the light, and the striæ themselves, which do not reflect, but appear as opaque or dark lines in a bright shining background.

Further observation seems to show that this means of detecting striæ can in many cases be used to advantage, especially where the surface to be examined is of considerable extent, the task of observation being materially facilitated without impairment of reliability. The striæ show best when observed in the direction of their drift trend, and with the angle of reflection large, forty-five or more degrees.

The above observations were made early in April in connection with a visit to Mount Monadnock, in New Hampshire; a covering of snow and ice preventing the taking of similar observations on the mountain at the time. It has since been learned, however, from Mr. C. L. Whittle, who has made a specialty of ice-movement over this mountain, that, as in the region of Orange, the striæ are now chiefly limited to the exposed edges of quartz veins traversing the granitic gneisses and other rocks which constitute the mountain.

F. C. Schrader.

Cambridge, Mass., May 2, 1896.

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*OCCURRENCE OF UINTAITE IN UTAH.**

The name Uintaite was given to the hard asphaltic substance to be discussed, by Prof. W. P. Blake in 1885. Subsequently it acquired the name Gilsonite, after a Mr. S. W. Gilson, of Salt Lake.

In appearance Uintaite is jet black, of

* Read by Mr. George H. Eldridge before the Geological Society of Washington, January 8, 1896, and reported with the author's approval by Dr. W. F. Morsell.

brilliant lustre, with powder and streak chocolate brown. It is brittle, with fracture conchoidal and hardness between 2 and 3; specific gravity, 1.07. The mineral is, like many others of the asphalt series, undoubtedly composed of a number of hydrocarbon compounds. Its position, from a physical standpoint, is at one end of the hydrocarbon series, petroleum, naphtha, and the gaseous substances being at the other, with the viscous malthas between.

Deposits of this hydrocarbon compound are, so far as present known, confined to the Uncompahgre Indian Reservation and its immediate vicinity in eastern Utah. The allied compound, Grahamite, occurs in West Virginia, and again in the Huasteca in the northwest part of the State of Vera Cruz, Mexico. Albertite, another near relation, has long been known in New Brunswick. It is quite possible also that many of the solid asphalts of other areas will, upon a more extended knowledge of their composition, be found to belong to one or another of these species.

The largest deposits of Uintaite are located along the Colorado-Utah line, 30 to 50 miles north of the Rio Grande Western Railway; others of workable width lie 40 to 50 miles west near the western edge of the Uncompahgre Reserve.

The deposits lie in the Uinta Basin, originally a structural basin, bordered by the Uinta Mountains and the Yampa Plateau on the north, the Wasatch Range on the west, the White River Plateau on the east, and the Roan or Book Plateau on the south. Erosion has greatly modified the surface appearance of the basin, the streams having cut cañons in some instances 3,000 feet in depth.

The geological formations of the basin proper are of Eocene Tertiary age and include the Laramie, Wasatch, Green River, Bridger, Washakie (?) and Uinta, the whole constituting a grand terrane of sandstones, shales and thin inconspicuous limestones.

The Uintaite is confined to no particular formation. It occurs as veins filling vertical cracks from ¼ inch to 18 ft. wide and from a few hundred feet to 5 or 10 miles in length. They have a general northwest-southeast trend. They cut shales, sandstones and limestones alike, and no displacement of the strata on either side of these cracks has ever been observed. The veins themselves, however, are faulted from 2 or 3 inches to 2 ft. Lateral cracks of wafer thinness are, in some instances, given off from the main vein, all filled with the asphaltic substance. The strata for a foot or two from the vein are often strongly impregnated with the Uintaite. Horses of the wall rock also occur, completely enveloped in Uintaite. The estimated contents of the veins to a depth of 1000 ft. is 20,000,000 tons.

Dr. Wm. C. Day (Journ. Franklin Institute, Sept., '95) has found Uintaite to consist of 56.46 % volatile matter, which is nearly or quite all condensable, 43.43 % fixed residue and 0.10 % ash; and that its percentage composition is

Carbon	88.30
Hydrogen	9.96
Sulphur	1.32
Ash	0.10
Oxygen and Nitrogen undetermined	0.32
	100.00

He speaks of it as comprising a number of radically different series of hydrocarbons, among which the paraffin series is one, and probably also the naphthene. No aromatic hydrocarbon appears to be present, or at most only in small quantity.

Uintaite is used in the manufacture of the cheaper black varnishes ($1.25 and down) and of japans, being especially prized on account of its elastic properties. It is in common use throughout the United States.

Within a region of 150 x 50 miles, in which the Uintaite all occurs in the eastern part, is found nearly all of the native asphalt series. The nearest neighbor is the Mineral Caoutchouc, Elaterite, or Wurtzilite, which in turn has at no great distance from it a substance with which it is said to have most intimate relations, Ozocerite, or Mineral Wax, and but a short distance from the latter is probably the highest grade asphaltic limestone in the United States. Maltha also occurs in the region; petroleum springs are also known, and the shales and limestones of the Green River formation are frequently found heavily impregnated with bitumen.

The region as a whole, therefore, offers a most advantageous opportunity for the study of the field relations of hydrocarbons.

RUINS OF QUIRIGUÁ.

The village of Quiriguá is about 20 miles to the west of Izabal, in Lat. N. 15° 15′ and W. Long. 89°. Nine miles away are the ruins situated on the left bank of the Motagua. Dense tropical forests cover the hills and valleys for miles around, and the only means of approach is through narrow mule paths till within some two miles from the ruins, when a passageway has to be cut by the 'mozos,' or Indian guides, with their machetes. The trees are of immense size, mahogany, ebony and lignum-vitæ being plentiful. Creepers and vines of all kinds hang down from these trees, making travel both dangerous and difficult in a tropical region where venomous insects and reptiles abound.

The first one sees on reaching the ruins is a small lake which the Indians have named 'Lake of the Idols.' An artificial mound built of small stones is within a stone's throw of the lake. As many of these rocks are of very fine marble, they probably came from the bed of the Montagua river, two or three miles away. At the base of this mound there are three obelisks 16 to 18 feet high. Each has a human face sculptured on its south side. The features of these faces are generally flattened about the forehead, the under lip large and hanging, the upper quite short, flat nosed and very large eyes with a staring look. The mouth is open in most cases and there appears to be a slight growth of beard. The other sides of these obelisks are covered with hieroglyphics enclosed in squares, many representing animals, trees, etc.

In a southerly direction we find the largest of the six obelisks, this one being 26 feet high, 5 feet wide and 4 feet thick. It is 12½ feet out of the perpendicular. It is quite probable that fully 6 or 8 feet of these shafts are buried in the soil. All the sculptured parts of the inclined obelisk of Quiriguá are certainly finer and more elaborate than on the others, the features are more regular; the nose, which is a foot long, is much sharper and the lips are not so full. The mouth is eight inches wide and the left side is broader than the right. The ears are square and are adorned with rings. The head is covered with a species of helmet shaped like a human face; the south side is similar to the north side already described, whilst the east and west have each a double row of squares containing hieroglyphics to the number of forty.

A few feet away lies an obelisk which was standing a very few years ago, according to the guides. The face on this one is different from the others; for instance, the ears are round instead of square and are formed of three concentric circles. This shaft is 18 feet high, 4 feet wide and 3 feet thick. The present condition of the sixth obelisk is not as good as some of the others. The face, which is 2 feet long by 1½ feet, has lost the nose, and the mouth is almost obliterated also; the ears are square and have no rings. Diagonally across the breast of the idol lies a child which is partly reclining on one hand. The quality of this work would seem to prove that the same artist made both this and the inclined shaft. The only difference in the face on the south side is that the ears are ornamented with rings. The east and west sides have each 34 rectangles arranged in pairs and all containing hieroglyphics.

As the land hereabouts is but slightly above the general level of the river, there is no doubt that the frequent inundations have buried many other monuments.

The idols of Quiriguá have no altars like those of Copan, but within the space occupied by the afore-mentioned, there are two immense stones which very probably served as such. The first one is nearly round, some 12 feet in diameter, and is situated a few feet from the first obelisk. The upper portion is painted red and a sculptured tiger's head can be made out, having a human head under it. A line of finely sculptured glyphs covers the back. What looks like a seat occupies the center, around which there are several grooves which run toward the floor. All this would seem to indicate the use of this stone as a sacrificial altar.

The second stone, which is between the fourth and fifth obelisks and to the east of them, is long and oval, being 6 feet high and 25 feet in circumference. The whole surface is covered with figures in semi-relief, which are in a much better state of preservation than those seen on the other monuments. One of these figures represents a woman without hands or legs, but with the arms extending to the floor. The forehead is narrow. Another figure is that of a turtle whose eyes are one foot across; representations of many fruits and flowers now found in the surrounding mountains, covered the rest of this stone. This fact seems to explode the idea of many regarding a change of climate, since the Central American cities, monuments, etc., were built.

There are several sculptured stones which are completely covered with moss and tropical vegetation and deeply imbedded in the soft humus. On one of them a tiger's head could be made out and wherever the moss could be scraped away hieroglyphics appeared.

The truncated pyramid of Quiriguá is some 28 feet high. Oblong blocks of sandstone have been used in constructing it, but the whole is a mass of broken rock to-day. There are two platforms on the pyramid, the second one having a series of circular niches, usually two feet in diameter and fairly well preserved.

Although the monuments of Quiriguá are larger than those of Copan, they are inferior in sculpture and their extremely weathered and ruined condition would prove them to be much older also.

Some historians have stated that Quiriguá was a large city, destroyed by the Aztecs when at the height of their power, on the plain of Anahuac. The site is indeed picturesque. To-day it is the abode of the denizens of the forest, reptiles seeming to have taken to it with special *gusto*.

JOHN R. CHANDLER.

GUATEMALA, CENTRAL AMERICA, April, 1896.

CURRENT NOTES ON ANTHROPOLOGY.

PRIMITIVE ETHNOLOGY OF FRANCE.

BASING his researches on the measurements of nearly 700 skulls and an examination of abundant artefacts of the palæolithic and neolithic periods, M. P. Salmon has constructed a map showing the ethnology of France in the stone age. The results arrived at may be briefly stated to be that the whole of the territory was down to neolithic times occupied by a people distinctly long-skulled, though probably of two different types. These were not violently dispossessed or exterminated, but more or less absorbed by two streams of short-skulled tribes, one from the northeast across the lower Rhine, the other apparently from Switzerland and beyond, down the Rhone. Later than these, at about the middle of the neolithic period, a long-skulled stock entered from the northeast or east, the shape of whose heads in other respects differed materially from the original inhabitants of Gaul.

It would be tempting to undertake the identification of these various peoples on the one hand with the protohistoric tribes whose names are mentioned by Cæsar and other early chroniclers, and on the other with types of the existing population. Some ethnologists have attempted this, but M. Salmon prefers to avoid such uncertain though alluring fields.

PALÆOLITHS FROM SOMALILAND.

THE 'palæolithic' implements from South Africa have long been known; but it is quite lately that specimens from East Africa, from the territory of the Somalis in the 'horn' of Africa, have been exhibited. Mr. Seton-Karr figures a number of them in the journal of the Anthropological Institute for February. In size and form they resemble the so-called palæolithic types. But we know that these types survived in neolithic ages, in many localities. We turn, therefore, to the evidence of their discovery in ancient strata. This proves not very satisfactory. They were found on or near the surface, and the only evidences adduced as to their alleged antiquity were their form and their weathering (patine). "Different ages and styles were found mixed together, some not much weathered, others extraordinarily so." This is surely far from conclusive as to their antiquity, and certainly would not satisfy an intelligent American collector.

COMPARATIVE ETHNIC ANATOMY.

THE anatomical differences between the so-called races or varieties of the human species have been examined with considerable attention but without satisfactory results. This has largely been owing to the personal bias of observers. Either, like Nott and Gliddon, they were determined polygenists, and were bound to elevate racial into specific differences; or they held the opposite views, and worked with an aim to efface apparent distinctions; or, especially of late years (*e. g.* Dr. Hervé, of Paris), they were so bent on seeing simian and pithecoid analogies that they lost sight of racial traits in atavistic reversions.

The vague resultant of such biased studies is seen in a discussion before the Anthropological Society of Washington, reported in the *American Anthropologist* for April. It was agreed that the term 'atavism' has been much abused by naturalists. Dr. Baker pointed out that food habits have a marked effect on osseous structures; he denied that the racial peculiarities of the negro are remarkably simian; many supposed racial criteria are merely the result of conditions which would produce them in any race; and he considered that anthropometry as at present taught is inadequate to define true morphological characters. These opinions are unquestionably well-founded, and they illustrate why so little is positively established in comparative racial anatomy after so much labor has been expended upon it.

D. G. BRINTON.

NOTES UPON AGRICULTURE AND HORTICULTURE.

THE AMERICAN PERSIMMON.

A STATION bulletin (No. 60, Indiana) has been issued upon the persimmon, and with several full-page plates of the tree and its fruit the subject is given a most favorable introduction. Prof. Troop shows that on account of the astringent principle in the unripe fruit, the tendency of the plant to sucker, and the long time before the tree comes into bearing, the plant has been neglected. By new methods of cultivation trees may begin to bear 'in three to five years from the bud or graft,' and the fruit is capable of much improvement and very likely will equal the Japanese sorts which are considered choice delicacies by many.

Under methods of propagation it is stated that, like the apple and many other standard fruits, the persimmon does not come true by seed, and therefore a variety needs to be continued by the ordinary methods, namely, by budding or grafting either of the stem or root. A plate is given showing a 'top-worked' old tree, and by grafting the comparatively worthless tree was made to bear a fine variety of persimmon.

When we bear in mind the revolution in grape culture in this country due to thorough work upon our native members of the genus Vitis, any similar study of another fruit group is welcome, fraught as it is with the possibility of adding a new fruit of no doubtful merit to our lengthening list.

PLUM-LEAF SPOT.

The camera and photo-engraving process are doing wonders for the Experiment Station bulletins. Number 98 of the New (Geneva) Station comes to us this week with five full-page process plates upon the plum-leaf spot. The results of a comparative study of the value of Bordeaux mixture and Eau celeste soap mixture are given. The Bordeaux is preferable and the first spraying should be made soon after the bloom falls. The same treatment also lessens the attack of fruit rot. The reader needs to see the plates to be impressed with the efficiency of the sprayings, for the loss is reduced from 86.5 per cent. to 17 per cent.

In similar spraying for the leaf spot of cherry no good results were obtained. But one swallow does not make a summer and one trial is not sufficient to condemn any spraying mixture.

FUNGICIDES INCREASE THE GROWTH OF PLANTS.

The use of fungicides is being looked at from various standpoints. Professor Galloway and Mr. Woods in a recent report from the Proceedings of the American Association for the Advancement of Science show from experiments and a collection of facts that the Bordeaux mixture has a marked physiological effect upon nursery stock, etc. Dr. Cuboni, of Italy, found milk of lime an advantage to grape vines. Dr. Rumm observed that Bordeaux gave better grape foliage even when no fungi were present. Dr. Frank and F. Krüger, also in Germany, found that chlorophyll is greater in sprayed foliage and all the vital processes increased, even to a lengthening of the life of the leaf. Professor Galloway has demonstrated that Bordeaux when added to the soil only has a stimulating effect upon the growth of the plants. The paper concludes as follows: "Whether the beneficial effect of spraying is wholly due to the presence of the mixture on the leaves, as concluded by Rumm, Frank and Krüger, or whether the presence of the mixture in the soil, as shown by the work of the division, may not, in part at least, account for the beneficial effect is still an open question."

VEGETABLE CULTURE.

The above is the title of a small work by Alexander Dean, F. R. H. S., of 136 pages, with 38 illustrations fresh from the press of Macmillan & Co. It covers the whole subject from the treatment of the soil, its preparation, etc., to allotment gardening. Under the latter the author writes: "The land hunger of the masses seems to be fairly satisfied where garden plots of from 20 to 40 rods in area are furnished, and rarely is it the case that these plots are not admirably cultivated." This method of garden culture is stimulated by societies which furnish lectures to the masses, publications in the shape of primers, etc. This portion of Mr. Dean's work will be particularly appreciated by those who are interested in a similar work for the city poor in this country.

The work before us is interesting in its classification of the products, or rather the crops of the garden. The first group is the tap and bulbous-rooted vegetables, including beets, carrots, onions, celeriac, turnip, etc., followed by tuberous-rooted vegetables, of which the potato is the leading example. Under pod-bearing vegetables are peas and beans, and the fruit-bearing vegetables include squashes, cucumbers, tomatoes. Cabbage and spinach are under green vegetables, while of edible stemmed plants, as asparagus, rhubarb and celery and representatives, and also the mushroom.

The handbook is quite English in the varieties it recommends, and the calendar for operations does not coincide with the one for our climate and seasons.

BYRON D. HALSTED.

SCIENTIFIC NOTES AND NEWS.

THE METRIC SYSTEM.

Appleton's Popular Science Monthly for June reprints the letters contributed anonymously by Mr. Herbert Spencer to the London *Times*, and endorses their point of view in an editorial article. The *Monthly* cannot but be admired for its allegiance to Mr. Spencer even in his vagaries, but it must be regarded as unfortunate that a journal whose readers will expect to find it represent the consensus of opinion of men of science should advocate the prejudices of the uninformed. We are not surprised to find that part of Mr. Spencer's contribution was written fifty years ago, and that the authorities he quotes are Sir John Herschel's article of 1863 and Prof. H. A. Hazen. But it was not to be expected that Mr. Spencer would confuse the metric and a decimal system, and argue that the former should not be adopted because the calendar cannot conveniently be divided decimally. Can the week be divided into quarters, eights and thirds, which Mr. Spencer rightly regards as desirable? If our ancestors had had twelve fingers in place of ten we should now have a better system of numeration, but the ideal and distant day, when we shall all do what is most reasonable, can be brought nearer by acting reasonably in the present and adopting the admirable system so rapidly becoming universal. For as Sir John Herschel wrote in 1863, "Were the question an open one what standard a new nation, unprovided with one and unfettered by usages of any sort should select, there could be no hesitation."

THE RÖNTGEN RAYS.

Nature gives an account of early experiments on the Röntgen rays by Prof. A Battelli and Dr. A. Garbasso, of Pisa. Referring to the discovery that the time of exposure required for taking photographs with these rays can be greatly shortened by placing certain fluorescent substances behind the photographic plate, the authors point out that they described a method of doing this in the January number of *Il Nuovo Cimento.* In some cases Prof. Battelli and Dr. Garbasso obtained good photographs with an exposure of only two seconds. In their paper experiments were also described proving that Röntgen rays can be reflected (or at any rate scattered) from surfaces, but indicating an absence of refraction. Since the appearance of the above paper Prof. Battelli has communicated two further papers to the same journal. In the first the author arrives at the conclusion that Röntgen rays behave as if they emanate from the base of the vacuum tube rather than from the anode or cathode, also that they are emitted even after the discharge in the tube has ceased (as proved by the discharge of an electrified disc in the neighborhood of the tube). In the second paper Prof. Battelli deduces that the rays which emanate from the cathode in a vacuum tube possess photographic properties; that their action increases as the rarefraction increases (at least up to $\frac{1}{200}$ mm. of pressure); and that some of the rays are deflected by a magnet, while others are not. It is hence quite permissible to maintain that Röntgen rays exist in the interior of the tube.

THE STORAGE OF WATER.

IN a lecture delivered before the Royal institution and printed in *Science Progress*, Prof. E. Frankland states that storage has an excellent effect upon the chemical and especially upon the bacterial quality of water. Thus the storage of Thames water by the Chelsea Company for only thirteen days reduces the number of microbes to one-fifth the original amount, and the storage of the river Lea water for fifteen days, by the East London Company, reduces the number on the average from 9,240 to 1,860 per cubic centimetre or to one-fifth; and lastly, the water of the New River Cut, containing on the average 4,270 microbes per cubic centimetre contains, after storage for less than five days, only 1,810, the reduction here being not so great, partly on account of the shorter storage, but chiefly because the New River Cut above the point at which the samples were taken is itself a storage reservoir containing many days' supply after filtration. Indeed, quietness in a subsidence reservoir is, very curiously, far more fatal to bacterial life than the most violent agitation in contact with atmospheric air; for the microbes which are sent into the river above the falls of Niagara, by the City of Buffalo, seem to take little or no harm from that tremendous leap and turmoil of waters, whilst they subsequently, very soon, almost entirely disappear in Lake Ontario.

Prof. Franklin holds that if the water of the Thames basin were properly collected and stored it would furnish London with an ample supply of excellent water for fifty years to come.

CRATER LAKE.

THE U. S. Geological Survey has issued a special map showing Crater Lake, Oregon. In the accompanying description Mr. J. S. Diller states that the lake is approximately circular and averages a little over 5 miles in diameter. It is reputed to be the deepest fresh water in America, having the remarkable depth of 2,000 feet. The steep slopes of the escarpment rise from 500 to 2,200 feet above the water, forming a remarkable pit. The average diameter at the top of the pit is 5.7 miles, and its depth is 4,000 feet. Nearly one third of its bottom is over one hundred feet below the level of Klamath marsh, at the eastern foot of the Cascade Range.

"The problem at once arises, How was this vast mountain, nearly six miles in diameter and possibly 5,000 feet or more in height above the present rim of the lake, removed, and the stupendous pit now occupied by Crater Lake produced? Did it go up or down? If it was blown out by an explosion we should find an enormous rim of fragmental material commensurate with the basin; but if it sank by escape of its molten interior through a lower outlet the rim would be small and composed of imbricated and overlapping sheets of lava and fragmental material. In fact, the rim is small and composed in large measure of solid lava sheets. It is evidently the peripheral part of the original mountain's base, and not due to accumulation at the time the basin originated. Maj. C. E. Dutton, who made a special survey of Crater Lake, compares it to Kilauea, of Hawaii, whose origin he attributes to subsidence of the material in a molten state owing to its escape at some lower level. The pumice upon the surface for many miles around Crater Lake was probably blown out at Crater Lake before the pit developed, and the volcano of Wizard Island was active at a much later stage upon the bottom of the pit. It was the scene of the last eruption about the lake, and, although recent in appearance, must have occurred centuries ago."

GENERAL.

THE New York Academy of Sciences has appointed a committee consisting of Prof. William Stratford, Mr. C. F. Cox, Prof. E. B. Wilson and Prof. G. S. Huntington, to solicit subscriptions on behalf of the Huxley Memorial Fund. As has been already stated in this JOURNAL, the fund will be used to erect in South Kensington Museum a memorial statue similar to those of Darwin and Owen, and secondly, if a sufficient amount of money be raised, to establish scholarships or a fund for original research. Contributions should be sent to Mr. Cox, Grand Central Station, New York.

DURING the Buffalo meeting of the A. A. A. S., Section H, anthropology will observe, as far as practicable, the following order of program:

Monday, address of the Vice-President, Miss Alice C. Fletcher; Tuesday, archæology; Wednesday, ethnology; Thursday, somatology and psychology; Friday, general anthropology.

AN International Congress of Hydrology, Climatology and Geology, will be held at Clermont-Ferrand, France, from September 28th to October 6th. The Minister of the Interior of the Republic has accepted the honorary presidency, and the government of the United States has been invited to appoint delegates.

DR. J. WALTER FEWKES will again conduct explorations for the Smithsonian Institution among the Pueblos of Arizona. He left Washington for a three months' expedition, on Saturday, May 30th, accompanied by Dr. Walter Hough, of the National Museum.

THE section of agriculture of the Paris Academy has nominated the following candidates, one of whom will be selected to fill the vacancy caused by the death of M. Reiset. In the *first class*, Mr. Müntz; *second*, M. Risler; *third*, MM. Laboulbéne, Maquenne and Th. Schloesing, fils.

THE first number of *Kantstudien*, a new 'Archiv.', edited by Prof. Hans Vaihinger of Halle, and published by Leopold Voss, Hamburg and Leipzig, was issued on April 25th. A special magazine devoted to Kent bears witness to the vitality of the critical philosophy in Germany, but will perhaps lead men of science to reflect that it is fortunate that they do not need to go back one hundred years and begin over again, as required by the philosophical program. The first number of the *Kantstudien* extends to 160 pages, and contains, in addition to an introduction by the editor, articles by Profs. Adickes, Vorländer, Stadler and Pinloche (the last in French), reviews and 'Kantiana.'

PROF. RÖNTGEN has been made a corresponding member of the Berlin Academy of Science.

WE learn from the *Naturwissenschaftliche Rundschau* that the mathematician, Prof. Ernest Padova died at Pisa on March 9th, and that Prof. Liebscher, director of the Agricultural Institute of Göttingen, died on May 9th.

THE New York *Medical Record* states that Prof. Ehrlich has been appointed director of the new State institute in Berlin for the testing of therapeutic serum and of the laboratory attached thereto.

THE Senate Committee has unanimously reported in favor of the bill restricting vivisection in the District of Columbia. The bill provides, first, for the use of anæsthetics in all painful experiments on living vertebrate animals, inoculation experiments, tests of drugs and medicines and cases of recovery from surgical procedure being exempted from this requirement; second, for the licensing of all experimenters by the District Commissioners, except those who are duly authorized officers of the government of the United States or of that of the District of Columbia; third, for the prohibition of vivisection in the public schools and in exhibitions for the general public; fourth, for the inspection of all places of experiment by inspectors to be appointed by the President of the United States. It has not been shown that any case of cruelty to animals by men of science has ever occurred in the District of Columbia, and the proposed legislation seems entirely useless.

WE learn from *Nature* that the Swedish Tourists' Club has organized an expedition to the Great Lake Falls next August. The object of the expedition is to give those who join it an opportunity of seeing the total eclipse of the sun on August 9th, on becoming acquainted with Lapland, and at the same time to see two of the waterfalls in Europe—the Great Lake Falls (Stora Sjöfallet) and Harspränget. The party will start from Gellivare on August 3d. Further information with reference to the journey can be obtained at the Tourists' Club, No. 28 Fredsgaten, Stockholm.

ACCORDING to the New York *Medical Record* the Wistar Institute of the University of Pennsylvania will receive, through the generosity of Gen. Isaac J. Wistar, a number of new buildings. The Institute was founded in 1892 for the preservation of the Wistar and Horner collections and for the promotion of study and advanced research in anatomy and biology. The most important of the new buildings will adjoin the present one, and will be used chiefly for the accommodation of the large number of specimens that have been contributed to the

Wistar and Horner collections during the past three or four years. A second building is designed to furnish heat and light to the Institute. When the Institute was established General Wistar endowed it sufficiently to provide for beginning the advanced and original work for which it was intended. Every facility will now be provided for the work of original investigators under the supervision of a competent director and skilled assistants. The grading of the ground previous to the erection of the new buildings has already been begun, and it is expected that the work will be completed by the beginning of the fall term.

THE managers of the Department of Natural Science Instruction in the National Educational Association are putting forth strenous efforts to make the first meeting of the new department a most successful one. Many scientific men have already signified their intention to be present to take part in the meetings. The scientific men of Buffalo have taken hold of the matter, also, and are now proposing to organize a New York State Association of Natural Science Teachers. The movement for better science teaching thus promises to spread rapidly, and it appears that there will now be afforded such an opportunity for the effective urging of better methods and better aims as has never before occurred. This movement should be of especial interest to college and university men, since it will deal largely at first with secondary instruction, or, in other words, with *preparation* for college, and it is hoped that many college men will be in attendance. The local Science Committee in Buffalo has designated the Genesee Hotel as headquarters. This is now the Y. M. C. A. Building, where so many of the meetings will be held. The officers of the department will be in attendance at headquarters early in the week to confer with teachers and all interested in science as a factor in education.

THE United States Civil Service Commission will hold an examination on June 9th to fill two vacancies in the position of Assitant Geologist in the United States Geological Survey. The competitors must possess certain linguistic accomplishments, but the examination will relate in the main to general geology and petrography, and one of the two appointed will be required to have a special training in economic geology. All competitors must show that they have had practical experience in the field under an expert geologist. The examination will be held in Washington and in other large cities where there are applicants. The number of competitors will be large. Persons desiring to compete should write to the United States Civil Service Commission, Washington, D. C. This is the first Civil Service Examination for the geologic force since the Survey was placed in the classified service, which covers all the scientific and technical places. Vacancies in other branches of the work have long been filled in this way.

IT has been reported to the State Department by the United States Consul at Aden that Prof. Daniel C. Elliot, of the Field Columbian Museum of Chicago, with Mr. C. H. Akeley and Mr. Dodson, who accompanied Dr. Donaldson Smith on his recent expedition to Lake Rudolph, in Central Africa, arrived at Aden, at the mouth of the Red Sea, on April 14th, and after a stay at that point of a week, securing men, camels and stores, proceeded on their scientific exploration into Central Africa, the main purpose of which is to collect specimens of the animals which are rapidly disappearing.

THE death is announced of Dr. Carleton Pennington Frost, Dean of Dartmouth Medical College and professor of medicine, who died on May 24th at the age of sixty-six; also of Mr. Thomas Maine, a mechanical engineer and the author of a work on the history of the steam engine.

THE Philadelphia *Bulletin* announces that work will probably soon begin on the Museum of Art and Science of the University of Pennsylvania, for which the city has turned over to the institution twelve acres of ground adjoining the site of the Philadelphia Museum. Plans have been completed for the building, which will be an imposing structure, costing upwards of $1,000,000. A portion of the appropriation from the State in 1895 was for the purpose of erecting the museum building. This appropriation, together with the private subscriptions, has raised the building fund to over $300,000, and it is probable that work will be begun on one wing of the structure this summer.

AT the recent *Conversazione* of the Royal Society, according to the report in the London *Times*, Prof. Roberts-Austen showed several curious experiments, which are modifications of one recently described by Margot, of Geneva. A fine wire of aluminium is heated to no less than 400 degrees above its melting point, but the wire, nevertheless, remains intact. This is owing to the formation of a fine film of alumina on the surface of the wire, and the metal, being very light, does not run into globules, as it might be expected to do. The molten wire has, moreover, a current passing through it and will, if approached by a similar wire or by a magnet, enable all the effects of mobile conductors carrying currents to be illustrated. One experiment showed that the molten wire can even be twisted on itself without rupture, and the effects of a tenacious thread of molten metal moving in response to electrical influences are very singular.

M. MÉLINE, who is Minister of Agriculture as well as Premier of France, has directed the professors of agriculture to suspend their lectures and to go through the rural districts in order to advise farmers to meet the failure of the hay crop by sowing vetches, maize and other fodder, as also by utilizing oilcake, straw, bran and corn.

AT a recent meeting of the British Astronomical Association, Dr. Gill, astronomer in charge of the Royal Observatory at the Cape of Good Hope, according to the report in the London *Times*, gave an account of the work in which he had been engaged. He mentioned first the completion of his investigation on the solar parallax and the mass of the moon, derived from observation of minor planets on a programme which he had prepared and which had been carried out at Newhaven, Leipsig, Göttingen and Bamberg, as well as at the Cape. The details of these results would be presented to the Congress of Directors of Nautical Ephemerides, which would assemble in Paris in May, and he would urge at that meeting the adoption of these constants for general use by astronomers. Dr. Gill also stated that the work of the geodetic survey of South Africa, which he had directed since 1885, was completed and printed, and that the report would be presented to the Cape Parliament in May. The first volume of the Cape *Durchmusterung* had been passed through the press. The whole of the latter work would consist of three volumes containing the places and magnitudes of 450,000 stars between latitude 18 deg. south and South Pole; it would be complete as far as magnitude 9.3 or 9.4, and would contain most of the stars as far as the 10th magnitude. A fundamental star catalogue for the equinox, 1890, containing the results of the Cape transit circle observations during the past ten years, was far advanced towards completion. Dr. Gill also mentioned that Mr. M'Clean's splendid gift of a powerful equatorial would now divert his efforts more to the field of astrophysics.

THE Washington *Star* states that a large invoice of plants for the department of botany has just been received at the Catholic University from Rev. Father Langlois, of Louisiana. This is the third donation of the kind Father Langlois has made to the University this year. Dr. Greene will leave for California shortly to collect specimens for his herbarium.

UNIVERSITY AND EDUCATIONAL NEWS.

THE United States Senate has passed the bill to charter the National University.

THE trustees of the College of New Jersey at Princeton, commonly called Princeton College, have filed in the County Clerk's office a certificate changing the name of the institution to Princeton University.

AT a meeting of about fifty friends of the Johns Hopkins University in Baltimore, on May 26th, the sum of $138,750 was subscribed toward meeting the deficit caused by the failure of the Baltimore & Ohio Railroad to pay dividends on its stock. It is hoped that $50,000 a year for five years may be subscribed.

MT. HOLYOKE COLLEGE has received $7,000 by the will of Miss Hitchcock, of Springfield.

THE twenty-fifth anniversary of President Angell's administration will be celebrated at the

University of Michigan on June 24th. Addresses will be made by Dr. W. T. Harris, U. S. Commissioner of Education, and Prof. J. O. Murray, of Princeton University.

THE University of Nebraska holds a summer school at Lincoln, from June 8th to July 3d, intended especially for teachers, principals and superintendents of the State. The courses of special interest to students of science are those offered in botany by Prof. Bessey and in physics by Prof. Brace. It is the intention of the University to offer next year courses in those subjects omitted this year. Thus, in 1897 zoölogy and chemistry will probably be offered in the place of botany and physics.

THE Board of Overseers of Harvard University have elected Theobald Smith, M. D., professor of comparative pathology; Charles Hubert Moore, A. M., professor of arts and director of the Fogg Art Museum; Lewis Jerome Johnson, A. B., C. E., assistant professor of civil engineering, and Comfort Avery Adams, Jr., S. B., assistant professor of electrical engineering.

OF the ten fellows nominated by the faculty of the University of Wisconsin only one is in the pure sciences—C. H. Bunting in biology.

PROF. W. WHITMAN BAILEY, of Brown University, has been appointed by President Cleveland, a member of the Board of Visitors to the United States Military Academy at West Point, where, it will be remembered, his father was many years professor, and where he himself was born February 22, 1843.

DISCUSSION AND CORRESPONDENCE.

'PROGRESS IN AMERICAN ORNITHOLOGY, 1886-95.'

TO THE EDITOR OF SCIENCE: In the *American Naturalist* for May, of the present year, there appeared a contribution of mine entitled 'Progress in American Ornithology, 1886-95,' and in a recent issue of SCIENCE (No. 73, pp. 777–779) Dr. J. A. Allen has undertaken to reply to such parts of that article as he considers to be of a critical nature as applying to the Committee of the American Ornithologist's Union, which prepared the last edition of the 'Check List of North American Birds.' In the present rejoinder I beg to assure my distinguished reviewer, at the outstart, that my article in the *American Naturalist* was not prompted through a spirit of 'animus,' as he seems to think, and that my 'reference to the starling clearly reveals that animus' is, surely, too ridiculous to be entertained even for a moment. Dr. Allen charges me with having overlooked 'the main purpose of the new Check List, which was the revision of the matter relating to the geographical distribution of the species and subspecies.' This omission was entirely intentional upon my part, and I preferred to leave it to other and more competent reviewers who have kept pace with that division of the subject during the last ten years, and who are for that reason far better prepared to deal with it than I am, who have not made any special attempt in that direction. That I did not refer to the matter of geographical distribution is any evidence that I underated its value is, to say the least, a curious inference. Upon similar grounds I might have been charged with underating the value of certain technicalities in scientific nomenclature, and of the necessity of typographical precision in the new 'Check List,' for I had nothing to say about them, and intentionally so. Other reviewers will doubtless turn their attention to such matters, and for the enlightenment of the A. O. U. Committee, and the consequent progress of American ornithology, point out the shortcomings in these premises likewise. Indeed, in *The Nidologist* for April of this year, a very good step has been taken in this direction. Through the assistance of the review to which I refer, I am prepared to say that I feel I have quite as much right to allow *Burrica* to appear in my article as *Barrica*, to which Dr. Allen has invited my attention, as he and the A. O. U. Committee have to spell 'probably' 'propably,' or Greenland with three e's, as they have in the new Check List (pp.221 and 321).

Dr. Allen has at last given to avian taxonomers a reason, *the* reason perhaps, why the A. O. U. Committee adhere so persistently to the superantiquated classification of birds to be found in the last Check List. It is because 'the species are numbered in an orderly sequence' and 'of the still very unsettled state of the subject of the relationships of various groups of birds.' If it is to be inferred from this that the Committee propose to adopt and print the classification of American birds in the various issues of the future Check Lists, that has just appeared in the last edition of that work, until such time as the relationship of the various groups of birds is *settled*, then I would most emphatically suggest that the idea of presenting a classification at all be at once abandoned and, for the 'convenience of correspondence between collectors,' simply print a 'list' of American birds, duly numbered in orderly sequence.

We might even carry the matter still further, and, as the scientific names of the birds are an abomination to the vast majority of 'collectors,' a 'list' of the vernacular names alone might be given, and these made alphabetical and duly 'numbered in orderly sequence.' What a simple science ornithology would become, and how convenient for the collector!

Now that Dr. Allen has had so much to say in his review about my 'presumptuous criticism,' and has totally ignored all the main points of my article in *The American Naturalist*, I should like to propose to him and to the A. O. U. Committee a few questions in reference to what we find in the new check list. I very much doubt their ability to answer them.

1. Upon what grounds are the Great Auk (*Plautus impennis*) and the Labrador Duck (*Camptolaimus labradorius*), both now admitted by the Committee to be *extinct*, retained in a list of *existing* North American birds?

2. Upon what grounds is *Crecoides osbornii* omitted from the List of Fossil Birds? (See Proc. Amer. Phil. Soc., v. xxx., p. 125.)

3. What consistency is there in admitting *Piranga rubiceps* to the list, and excluding (for one example among many) *Gubernatrix cristatellus?* [As the normal habitat of *P. rubiceps* is certain *high* altitudes of a few localities in Colombia and Ecuador (the species not even occurring upon the Isthmus of Panama, it would seem that Dr. Allen's comments on *Gubernatrix cristatellus* might, with equal consistency, be applied to it. Of the latter species he has said, "Its habitat being Brazil, it seems beyond probability that it could have reached the locality of its capture without human aid." (Bull. N. O. C., Vol. V., p. 240.)].

4. Upon what grounds are the Grebes (*Podicipidæ*) made to occupy a sub-order by themselves, and the Loons (*Urinatoridæ*) and Auks (*Alcidæ*) another and separate sub-order?

5. What have the Goat-suckers (*Caprimulgi*) and the Humming-birds (*Trochili*) in common, that they should be placed in the same order?

When Dr. Allen answers these questions satisfactorily to the many inquiring ornithologists the world over, and can *prove* consistency in their premises, then I shall believe my article in *The American Naturalist* to have been 'presumptuous,' but not before.

R. W. SHUFELDT.

The foregoing rejoinder by Dr. Shufeldt to my review of his paper on the A. O. U. Check-List of North American Birds requires no comment from me as regards his article in general, as I do not recognize that he has scored any points worthy of notice; the series of four questions he asks at its close may be considered as demanding some attention. In regard to the article referred to by Dr. Shufeldt in *The Nidologist*, the leading points made by the writer thereof are not well taken, as will doubtless be shown in a future number of that journal. To place emphasis on the presence of two typographical errors—the extent apparently of their discoveries in this direction—as both writers have done, is rather a compliment than otherwise to the Committee.

1. The Great Auk and the Labrador Duck. Dr. Shufeldt raised the same issue in his original paper, but it did not seem necessary to take up the space of SCIENCE to discuss it. Both species are practically members of the present fauna, as distinguished from 'fossil birds,' commonly so called, the former living till about the middle of the present century (specimens were taken as late at least as 1844), and the latter till at least 1875, or till within twenty years, and not a few ornithologists believe that some may still exist. Both species are still retained in all recent manuals and general works on North American birds as properly 'North American Birds' in the sense of the Check List.

2. *Crecoides osbornii* Shufeldt. This was omitted simply because it was accidentally overlooked.

3. *Piranga* '*rubiceps*' = *rubriceps*. If Dr. Shufeldt makes no protest against *Icterus icterus* and *Spinus notatus*, admitted to the list on Audubon's authority, he should not object to the case of *Piranga rubriceps*, the geographical conditions being similar. So far as known, *P. rubriceps* is not kept as a cage bird ; certainly it is not one of the commoner cage birds of our bird stores, as is *Gubernatrix cristatellus*. Many of the common cage birds escape from confinement and are afterwards captured, perhaps after a considerable interval of freedom, and showing very few, if any, traces of previous confinement. Among them are finches, parrots, and parrakeets from Africa, India, Australia and tropical America. Their capture may be recorded as a matter of interest, but no one considers it admissible to include such species in the list of North American birds. On the other hand, wild birds either wander or are carried by storms hundreds and even thousands of miles beyond their usual range, and are captured under circumstances which preclude the supposition of their being escaped cage birds, as in the case of many European stragglers that have occurred once, or a few times in North America. To this class of waifs belongs *Piranga rubriceps*.

4 and 5. Regarding the relationships of the Grebes, Loons, Auks, etc., probably if the A. O. U. Committee were to revise its classification they would make some changes in respect to the position of these groups; but, for reasons given in my former letter (SCIENCE, N. S., No. 73, May 22, 1896), the Committee did not consider it advisable to transpose any of the higher groups. But the Committee doubtless would not follow Dr. Shufeldt in removing the Owls from the Acciptires to place them with or near the Goatsuckers.

J. A. ALLEN.

'THE POLAR HARES OF EASTERN NORTH AMERICA.'—AN ANSWER TO DR. C. H. MERRIAM'S CRITICISMS.

TO THE EDITOR OF SCIENCE: Dr. C. Hart Merriam has seen fit to devote nearly two pages of SCIENCE* to my preliminary paper on the 'Polar Hares of Eastern North America.'

It is difficult to ascertain the motive which prompted this review of my preliminary work on the Polar Hares, the mature results of which I expressly stated in the *American Naturalist*,† would soon be published in the form of a compendious revision of the New World representatives of the *Lepus timidus* group. The importance which Dr. Merriam seems to attach to the paper in question, by devoting thereto three times the space taken by his succeeding review of Sclater and Thomas' new 'Book of Antelopes,' together with the suprising attitude taken on certain questions of nomenclature and diagnostic technique, demand a rejoinder.

Waiving the objections made to my reëstablishment of the specific distinction of the American from the European Polar Hare, and my rerestriction of the type locality of the latter to southern Sweden, let us consider Dr. Merriam's position regarding my adoption of the name *arcticus* of Ross for the Baffin Land Hare instead of *glacialis* of Leach, which comes nineteen pages later in the same book. In the absence of any statement to the contrary, I proceed on the supposition that Dr. Merriam still agrees with me in taking the Code of Nomenclature of the American Ornithologists' Union for authority in a case of this kind.

His main objections to the use of the name *Lepus arcticus* 'Leach,' Ross, are :

(1) "Capt. Ross was not a naturalist and made no claim to technical knowledge of zoölogy."

(2) "All that he [Ross] knew of the animal came from Leach."

(3) "Ten persons have used the name *arcticus*, while thirty-six have used the name *glacialis*."

(4) "Irrespective of the merits of the two names, *glacialis* would have to be taken if we accept the rule that in cases of names of equal pertinency, the first reviser of the group has the privilege of fixing the name."

The first objection only begs the question. The rules of nomenclature no longer attempt to define what should constitute the standard of authorship, contenting themselves in such a

*Friday, April 10, 1896, pp. 564, 565.

† March, 1896, p. 256.

case as this to the definition of what constitutes a valid naming and description of genera or species. Would Dr. Merriam have us estimate the personal equation in the authorship of names proposed by such a man as Rafinesque because he fell so far below the scientific standards of a Leidy? Livingstone was 'only a missionary' and Krider a 'gunmaker,' but science is willing to say " 'A man's a man' and priority is priority 'for a' that.' "

The second objection made by Dr. Merriam is not only as irrelevant as the first, but is based on an incorrect statement. Ross knew more about the specimen than Leach did, and the latter was more indebted to Ross for points as to the animal than Ross was to Leach. They described the same specimen, and, besides giving all the diagnostic characters described by Leach, Ross adds two important ones and gives the collector, locality and date of capture of the specimen, which Leach omitted entirely. In short, Ross' description is the better of the two.

As to objection number three, the inconsistency of the numerical argument thus advanced by a member of the A. O. U. Committee on Classification and Nomenclature* favoring the old standard of 'time-honored' custom, and consensus of opinion in a question of 'equal pertinency' in specific names, strikes me as no less lamentable than subversive of the best interests of that department of American science which aims at canonical permanency in the rules of nomenclature.

The fourth objection is based on a private interpolation into the canonical code even more obviously heterodox than objection number three. I would ask Dr. Merriam where he finds the 'rule that in cases of equal pertinency the first reviser of the group has the privilege of fixing the name?' I do find in the A. O. U. Code of Nomenclature, on which Dr. Merriam has frequently had occasion to publicly pledge his faith, under Canon XVII., relating to 'Preference between competitive specific names published simultaneously in the same work * * *,' a section 3 which reads, 'Of names of undoubtedly equal pertinency and founded upon the same condition of sex, age or season, that is to be preferred which stands first in the book.' To my mind this completely covers the matter at issue and justifies my course in adopting *Lepus arcticus* as the proper name of the Baffin Land Hare.*

* Dr. Merriam was recently appointed on this Committee in place of Mr. Henshaw. See Check List N. A. Birds, 2d ed., 1895, p. vi., foot-note 1.

Regarding his criticism of my use of the Scandinavian *L. timidus* as the basis of comparison in a paper on American Polar Hares, I need make no apology. Dr. J. A. Allen's monograph of the American Hares was taken as the last authoritative declaration of an American mammalogist on the relations of these animals, and, as he failed to recognize the distinctions which I found to exist, it was reasonable that they should be demonstrated by the plan of comparison adopted in my paper.

Instead of outlining the scope and aim of my paper and stating that I had endeavored to show the close affinity, but specific distinction of the Baffin Land and Scandinavian Hares, and their great differences from the Hare of Greenland, which previous authors have more or less confounded with *L. arcticus* of Ross, my critic chiefly devotes himself to a justification of his own peculiar views on the subject of names, methods and forms of expression.

Dr. Merriam ventures no opinion as to the status of what he spells '*L. greenlandicus*' in his critique, and from his own admissions he evidently knows less about the animal than many of the authors whom he cites to support his 'time honored' but mistaken opinions.

To cap the climax of unjust sarcasm, the chief apostle of generic, specific and subspecific subdivision in this country draws a parallel between my naming of the Labrador and Newfoundland subspecies, *L. a. bangsii*, to the separation of 'weasels that turn white in winter from specimens of the same species that remain brown the year around!' Shall I answer such logic? Not until I have more time and SCIENCE more space for unscientific contro-

* Since these remarks were written, I find that Dr. J. A. Allen fully endorses the position I have taken, in his answer to an inquiry made by Mr. Witmer Stone, on this and kindred subjects, treated in the 'Correspondence' of the April issue of the *Auk* for 1896.

versy. Then, perhaps, Dr. Merriam will tell us whether he continues to recognize *Lepus americanus* and its subspecies *L. a. virginianus*.

SAMUEL N. RHOADS.

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA, April 17, 1896.

AMERICAN POLAR HARES: A REPLY TO MR. RHOADS.

THE above wail from Mr. Rhoads respecting my review of his paper on the Polar Hares calls for a brief reply. It was not the importance of Mr. Rhoads' paper, as he seems to suppose, but the importance of certain principles involved in his methods of treatment, that led to the length of my review. My criticisms were aimed mainly at two matters: one, a matter of description; the other a matter of nomenclature. In describing the new American hares, Mr. Rhoads contrasted them with a European species (*Lepus timidus*) instead of with their American relative (*Lepus glacialis*). This struck me as bad systematic zoölogy. In treating the Polar hare of Baffinland he adopted the specific name *arcticus* instead of *glacialis*, though both names appeared simultaneously in the same book. This struck me as bad nomenclature.

The reasons for retaining *glacialis* as the proper name of the animal were stated at length in my review and need not be repeated here. But in his reply Mr. Rhoads implies that I have subordinated priority to the scientific standing of an author. This I deny. Priority of publication is the cardinal principle of nomenclature—the foundation of all modern codes; without it, stability in nomenclature is impossible. But priority of *publication* and priority of *pagination* are two widely different things, and I deny that priority of pagination constitutes priority of publication. It can hardly be gainsaid that the different pages of a book appear simultaneously; hence names on different pages of the same book should be treated in the same way as names appearing simultaneously in different books. Sequence of pagination is a trivial circumstance, not to be considered in fixing specific names except in cases where no other reason for a choice can be found. Even the A. O. U. Code quoted by Mr. Rhoads concedes this, and goes so far as to accord greater weight to *sex*, *age* and *season* of the type specimen than to priority of pagination. In other words, in choosing between names of even date, sequence of pagination is a last resort.

It is useless to enter into a controversy with Mr. Rhoads over his astonishing statement that of the descriptions of the American Polar hare given by Ross and Leach, "Ross' description is the better of the two." Reference to the work in which both appeared will settle this point.

In reply to Mr. Rhoads' inquiry as to the source of the rule that 'in cases of equal pertinency the first reviser of the group has the privilege of fixing the name,' it may be stated that said rule expresses the practice of most systematic zoölogists—and I think botanists as well—and is in complete accord with the spirit of the A. O. U. Code, though not there formulated as a distinct canon. In closing, I must thank Mr. Rhoads for calling my attention to what he considers would have been a proper review of his paper.

C. H. M.

THE SUBJECT OF CONSCIOUSNESS.

TO THE EDITOR OF SCIENCE: In the number of SCIENCE for May 15th there is a letter from Johannes Rehmke on the subject of 'consciousness,' about which I beg leave to be indulged in a brief statement.

Take two equal weights with handles, one weight being several times the bulk of the other. Ask a blindfolded man to tell which is the heavier, being careful not to let him touch either weight, but only the handle, and he will not judge of a difference. Now let the same man, seeing the weights, but not knowing them to be the same, decide which is the heavier; he will affirm that the smaller is the heavier weight. This is a common experiment in psycho-physics. There are on record a vast number of similar experiments which have been abundantly verified, all leading to the conclusion that there are two elements in sensation, the one of consciousness of the effect upon self and the other an inference relating to the thing observed by any one of the senses. All of these experiments, and a vast body of experiences which every individual undergoes, testify to these two elements. At the last meeting of the National Academy I presented a paper on this subject, from which I extract the opening paragraphs, as follows:

All operations of the mind are judgments. On examining the nature of the judgments we discover two elements or functions, consciousness and inference. Consciousness is awareness of self and change in self, and inference is a guess at the cause of the change. We can discover these functions or elements in all of the judgments of mind. I am conscious of a sound; I infer that it is the voice of a friend. I am conscious of an odor, and infer that it is caused by a rose. I am conscious of a flavor, and I infer that it is the taste of an apple. I am conscious of a sense impression of color, and I infer that it is caused by a tree. These judgments may be erroneous and I may believe in illusions, but in every case a judgment is formed, whether correct or incorrect. The condition under which judgments produce illusions or certitudes will hereafter be set forth. That which we have to consider now is that in every mentation, whether true or false, as in the perceptions mentioned, there is a consciousness and an inference. It will be noticed that we have defined the term consciousness as awareness of change in self, and to this definition we shall adhere. The word is used in many other senses, but in science it becomes necessary to use words with a single meaning. For example, we might use the term consciousness to mean also the cognition of self or another, and it is often used in this manner as a general synonym for cognition, but we must have some term to designate awareness of the change in self and select the word consciousness for that purpose, as that seems to be its fundamental meaning.

A consciousness is awareness of change in self, so inference is the interpretation of the meaning of that change. A change has been effected upon my organ of hearing, and I am conscious of a sound and interpret it as a voice; this interpretation is inference. It is not a random guess, but a guess dictated by experience or some collateral circumstance which suggests this guess. Consciousness, therefore, is not only independent, but it is also absolute in the sense that it must have reality as a change in self; the inference is not only dependent, but it is also subject to error. It may be a certitude or it may be an illusion. Thus, there is either a certitude or an illusion produced by an inference. How then does the mind distinguish between certitudes and illusions? Here we have to consider cognition.

Verification is the proof of the inference by experience. Cognition is composed of three functions: consciousness, inference, and verification. That which is produced by cognition is certitude. A judgment is composed of two functions—consciousness and inference; if verification is added by experience it becomes a certitude; if it is not verified by experience it is proved to be an illusion. These may seem very simple propositions and self evident, as they are, yet they are fundamental and must be clearly understood in order that proper progress may be made in the study of cognition.

What I have designated as consciousness and so defined the term Rehmke designates as subject of consciousness; what I have defined as inference he calls attribute of consciousness. But I go on to use judgment in a restricted sense as based on a consciousness and an inference, and then use cognition as a mentation of three elements—consciousness, inference and verification. As I understand Rehmke's method of defining the two terms of consciousness, he makes a valid distinction which is fundamental in psychology and if properly and rigidly observed dispells many illusions in psychology, and experimental psychology has abundantly demonstrated Rehmke's position.

I regret that I have not seen Rehmke's book, and on consulting the four papers of SCIENCE for last September I do not discover that it was reviewed therein as indicated by his remarks.

In the judgments formed in the experiment with the two weights the blindfolded man makes a judgment of relative weights; the seeing man makes a judgment of relative specific weights. Having in advance seen the weights, he has already formed a judgment and uses this judgment of sight in interpreting the consciousness experienced through the sense of muscular strain. The psychology of sensation and perception cannot be understood or explained without using distinct, definite and understood terms for what I have called consciousness, inference, judgment, verification and cognition. What terms shall be used matters little; it may be that Prof. Rehmke's use of subject of consciousness and attribute of consciousness is wise, but I fear that it will make still greater confusion in a subject which is already burdened with terms, and it seems to me better to follow the example of the physicists in giving restricted meanings to words already in use, as in the case of momentum, energy, force and power, and then rely upon the acceptance of the terms with the restricted meanings.

J. W. POWELL.

WASHINGTON, D. C., May 16, 1896.

SCIENTIFIC LITERATURE.

Text-book of Comparative Anatomy. By ARNOLD LANG. Translated by H. M. and M. BERNARD. Part II. London and New York, Macmillan & Co. 1896. 8°. Pp. xvi+618, with many illustrations.

The second part of this well-known text-book has been impatiently awaited by teachers of invertebrate anatomy and those who desired a convenient work of reference summarizing the essential facts of the science. Among the numerous text-books of this sort which have appeared of late years, each of which has had its especial merits, that of Lang has reached an easy preëminence, on account of the wide erudition and judicial temper with which the different topics are treated. It is, of necessity, in one sense, a compilation and the chief criticism which has been made upon the German edition is that the authorities for the facts used are cited in mass as literature and not in connection with the particular data due to each. Prof. Lang explains that considerations of space made this obligatory, though, naturally, the work, as a book of reference, would have gained in value as well as size by specific citations. The translation, on the whole, is easy and idiomatic, only occasional Teutonicisms are noted, though it would seem as if some more apposite term than 'Appendage' might have been used for the supplementary chapters on *Rhodope* and *Rhabdopleura.* The typography of the English edition is much more tasteful than that of the original; the illustrations are well printed, and the work will doubtless receive a wide and merited acceptance as a text-book. The present volume includes *Mollusca*, *Echinodermata* and *Enteropneusta*, but the special criticism on this occasion will be confined to the mollusks.

It would be superfluous, perhaps, to criticise in this place the general plan upon which such text-books are constructed, but it cannot be denied that the comparison, organ by organ of a multitude of animals, leaves a somewhat incoherent impression upon the mind. As things are constituted, anatomists are rarely systematists and the systematic part of any of the manuals leaves much to be desired by the specialist. The ideal comparative anatomy would relegate the specific facts to eminent specialists and the comparisons to a systematic genius as editor, a state of beatitude which we are far from approaching.

Prof. Lang is not an eminent specialist in mollusks, but he has a wide knowledge of the literature, and his remarks on mooted points are generally characterized by good sense and sound judgment. The compendium may be said to be, as a whole, representative of the date of 1889, though, in some instances, the text shows later references.

In selecting an architypal mollusk with which to compare his actual animals, the author has followed Lankester's hypothesis of 1884. The architype is regarded as an animal somewhat between *Fissurella* and *Chiton*, bilaterally symmetrical with a posterior vent and straight alimentary canal. We are of opinion that Prof. Verrill's suggestion that the architypal mollusk in the main conformed to the type of the molluscan veliger, with a bent intestine and anterior vent, is much more in harmony with our knowledge of the facts; but space forbids a discussion of the question here. The classification of the Pelecypods is adopted from Pelseneer, whose method has been of late pretty thoroughly tested and found wanting, though at the time this text-book was in the making, it was the newest and presumably the most satisfactory. On the whole, however, Prof. Lang has succeeded in bringing together the data in an excellent manner, and the cordial reception of the German edition is sufficient evidence of the estimation in which his work is held by his scientific colleagues.

Since this work will undoubtedly take a prominent place among the text-books used by teachers, it will not be regarded as hypercriticism to use the remainder of our space in pointing out such items as, on a general perusal, have appeared contestable, erroneous or obsolete. Any work of this kind necessarily contains a certain percentage of such slips, and their presence cannot justly be regarded as condemning it above its fellows. Their correction, therefore, is not to be taken as diminishing the high opinion of the merits of Prof. Lang's work which we have already expressed.

The bloodvascular system of mollusks (p. 1) is not 'open' in the ordinary sense of that word, but closed, though partly lacunary.

In the true Diotocardia an intromittent male organ is absent chiefly in the littoral species, having been shown to exist in many deep water forms such as *Cocculina*, *Addisonia*, *Fissurella*, *Solariella*, many *Puncturellidæ*, etc., and it should not, therefore (p. 4), be predicated of the entire group. The arrangement of the *Tænioglossa* is imperfect (p. 6); the *Capulidæ* have a retractile proboscis and are therefore not 'Rostrifera.' The *Columbellidæ* are not *Tænioglossa*. *Janthina* can hardly be called siphoniferous.

The nudibranchiata are not all destitute of a mantlefold (p. 10), at least if that fold be defined with any consistency, *e. g.*, *Pleurophyllidia.*

The gymnosomatous pteropods (p. 11) do not feed chiefly on *Thecosomata*, but on hydrozoa. The absence of a mantle is merely nominal, that organ being coincident with the integument, in any practical view. The arrangement of the Decacerate cephalopods is antiquated (p. 24); *Spirula* is undoubtedly Oigopsid.

Throughout the work (cf. p. 26) conchioline is more or less confused with chitine. The periostracum of bivalves is referred to as chitinous, by the majority of writers, as well as Lang, but long ago Loew showed that the chitine of mollusks (jaws and radula) does not give a saccharine reaction with sulphuric acid, and is not therefore identical with ordinary chitine, while the conchioline of the periostracum and test is purely horny, dissolving with ease in liquor potassæ and in no respect chitinous.

The spines of *Amphineura* are homologized with the shell of *Chiton* (p. 29) and later the tegmentum of the chiton and its 'aesthetes' are correctly homologized with the corium of the girdle and its spines; it seems surprising, therefore, especially when the embryology of *Dondersia* and *Chiton* is considered, to find (p. 40) an attempt at homologizing these cuticular structures not only with the true shell (articulamentum) of *Chiton*, but even with the shell of mollusks in general. The shell of *Argonauta* (p. 38) is a product of secretion from the cuticle, serving the purpose of an oöphore, and should not be homologized with the protoconch and concha of other cephalopods. The figure of *Chitonellus* (more properly *Cryptoplax*) is taken from a very contracted spirit specimen and fails to show the proper proportions of the foot. Speaking of the concrescence of the mantle margin in Pelecypoda (p. 51), it should be stated that several superanal foramina occur in Naiades occasionally, and the fourth ventral orifice in *Pholadomya*, etc., is with little doubt correlated with the opisthopodium and not with the byssus. We find no reference to the opisthopodium in the book. The extensive concrescence of the mantle edges (p. 52) is not 'always' accompanied by 'well developed siphons,' *e. g.*, *Tridacna*, *Chama;* and the same examples show that the statement that in sessile forms the mantle is found completely open is far from being generally true.

In discriminating the ligament and resilium the latter is said (p. 61) to be elastic and the former not so; in fact, both are elastic and the resilium adds resiliency to its tensional elasticity. Paleontology shows the error of the statement (p. 63) that the Pectinidæ are probably derived from sessile forms. The gape in many bivalves is accounted for (p. 64) by 'the greater development of siphons and foot' which is merely an incident of the gaping; the true reason is to be sought in the less need of shelly protection among deep burrowers; Pholads (p. 65) are said to rasp the stone by the edges of the valves. While this is true of certain forms like *Teredo*, in many others, including most Pholads, the rasping is done by the surface of the foot. The snout in *Capulus* (p. 102) is erroneously stated to be not invaginable. It is really invaginable from the base, much as in *Dolium*. The filamentous 'tentacles' (= captacula) of Scaphopods are not homologous with the tentacles of Gastropoda. In treating of the epipodium, mention might have been made of its modification to serve as a seminal conduit in certain Trochids. The *Unionidæ* (p. 115) are not, as a rule, mud dwellers. The musculation of *Chiton* (p. 120) has recently been fully described by Lillian Sampson. The statement that the muscles of mollusks are never striated (p. 119) is not true literally (p. 124), but the differences between their striation and that of vertebrates should have been explained. Burne has recently shown that a supraœsophageal commissure exists in *Hanleyia abyssorum* and probably in other chitons, as well as one (p. 129) below the œsophagus. *Cassidaria* (p. 163) does not belong to the *Toxiglossa*. The jaw, frequently, and the radular teeth always are not, as stated (p. 177), composed of conchioline, but of a special sort of chitine. The basal membrane of the radula (p. 181) is not 'rough' and not formed of conchioline. The transverse rows of the teeth (p. 182) properly counted invariably resemble one another; an alternation of discrepant rows is unknown, except as a blunder in defining the row. The accepted name of the central teeth is rhachidian, and not rhachial. In certain *Toxiglossa* the basal membrane of the radula is represented by two separated very narrow strips. The sucker-like organ on the proboscis of *Natica* is probably an organ of prehension; there is no evidence that it has anything to do with the boring by which the animal penetrates bivalve shells. In the naiades (p. 262) the young are not always developed in the outer gill, but also in the inner or in both, in some cases. The marine *Philobrya* also has a glochidium, while the whole family of *Mutelidæ* are without this commensal stage.

The above inaccuracies are due largely to the habit of anatomists of generalizing too widely on a too slender basis of observation. This might once have been excusable, but fortunately is rapidly becoming no longer so.

W. H. DALL.

Die Bronzezeit in Oberbayern. By VON DR. JULIUS NAUE. 4°, pp. 292. With album of fifty plates. Piloty & Löhle, Munich.

Southwest of Munich, amid the lovely scenery which surrounds the Ammer and Staffel Lakes, a number of sepulchral tumuli were discovered some years ago, which on investigation dated back to the age of bronze, ranging in time from its earlier to its later periods. Fortunately for prehistoric science, they attracted the attention of Dr. Julius Naue, of Munich, and he set about their thorough and accurate examination. For fifteen years he has personally explored them, spade in hand, surrounding his digging with those numerous precautions which the field archæologist should always respect.

Before his researches, practically nothing was known of the conditions of the peoples of the bronze age in the region indicated. By the opening of more than three hundred burial mounds and the sedulous study of their contents, he is able in the handsome volume named above to offer an almost complete restoration of the culture of that remote epoch.

In the older graves there are abundant utensils, weapons and ornaments of bronze; bowls, jars and plates in earthenware, frequently in artistic forms and decorated externally in lines and spirals; and a quantity of amber. No other metal was exhumed. Only in the later graves very small objects in gold and pearls of glass appear, but iron and silver continue unknown.

The text presents first the notes of each excavation. Then follow detailed descriptions of the weapons exhumed, the tools and utensils, articles of ornament and pottery. Special studies are appended on the material and technique of the objects, their form, style and ornamentation, and the inferences which they enable the student to draw regarding the people who left these memorials of their presence. The conclusions on the last topic are unexpected. We find ourselves in the presence of an industrious and peaceable community, depending on agriculture almost exclusively, cultivating the soil diligently and raising herds of cattle. They wore woolen clothing, with ornamented leather belts and decorated with bronze plates. They were of good stature, the men 1.65–70, the women 1.60–65. They were firm believers in a life after death, and surrounded the corpse with such objects as it was supposed to require in its wanderings in spirit land. Women took a high rank in the community as queens and priestesses. Some of the most elaborate of the interments preserved their remains only.

The culture was a progressive one. It can be traced from the neolithic time through the whole of the bronze age down to the epoch when the Roman forays destroyed it. Slowly but steadily it had increased, and for centuries a state of comparative peace must have prevailed to permit this uninterrupted growth.

The numerous illustrations in the text and the admirable album of fifty-full page plates present in the most satisfactory manner the results of these important and suggestive excavations. D. G. BRINTON.

Current Superstitions Collected From the Oral Tradition of English-Speaking Folk. Edited by FANNY D. BERGEN, with Notes and an Introduction by WILLIAM WELLS NEWELL. Pp. 161. Price, $3.50. Boston, Houghton, Mifflin & Co.

The strange persistency of ancient superstitions in conditions of modern civilization is well illustrated in this volume. Its peculiar value consists in its presentation of beliefs and practices widely prevalent in our own day and country, most of them having been obtained by private correspondence with persons in various parts of the United States.

They are arranged under nineteen headings, such as love, marriage, dreams, luck, money, weather, warts, moon, sun, death omens, and 'projects.' The last mentioned is the term applied among girls in the United States to the ceremonies of divination by which they learn about the man they are to marry. The editor, Mr. Newell, says he cannot offer any explanation of this signification attached to the word. Is it not a direct descendant of the Latin *projicere sortes*, divination by casting on the ground the divining sticks? This seems borne out by the fact that the most widely extended of these 'projects' is to throw a whole apple paring on the floor, where it forms your true love's initial letter.

The introduction and notes, prepared by Mr. Newell with his customary thoroughness and precision, add much to the value of Mrs. Bergen's collection by bringing out the analogies of the customs mentioned with the folk-lore and mythologies of other times and nations.

Among other noteworthy facts thus elicited is the vitality and number of formulas and beliefs still current in reference to the moon. So extended are these that Mr. Newell says they must be regarded as 'Nothing else than a continued worship of the orb, still connected with material blessings expected from its bounty.' The sun is decidedly less important in popular belief.

Folk medicine is represented by the wearing of amulets and charms, the magical cure of warts, hiccough, toothache, nose bleed and other common ailments. Attention is called by the editor to the fact that in some of these the ancient 'doctrine of signatures' still survives.

Of the incidents of life, the two around which is associated the largest body of living superstition are marriage and death. Mr. Newell explains the latter by the suggestion that "The disinclination to exercise independent thought on a subject so serious leaves the field open for the continuance of ancestral notions," which seems an appropriate solution. He adds some pointed observations on the value of folk-lore to history, comparative mythology and archæology.

The volume is a member of the series issued under the auspicies of the American Folk-lore Society. It is to be regretted that it is not furnished with an index, an omission scarcely excusable in a work of the kind.

D. G. BRINTON.

SOCIETIES AND ACADEMIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MAY 19, 1896.

THE collections made by Dr. A. Donaldson Smith in Western Somali Land and the Galla Country, northeastern Africa, in 1894, were presented to the Academy, their value and extent being commented on by Mr. Arthur Erwin Brown on behalf of the curators.

Dr. Donaldson Smith spoke of the physical features of the regions from which the specimens had been collected and gave briefly some facts regarding the habits of the animals observed by him. Somali Land is very arid and barren, yet a greater variety of specimens and more new forms had been secured there and from the 200 miles beyond than from all the rest of the 4,000 miles traversed by him. In illustration it was stated that twenty-three new species of birds had been obtained from the district specially referred to, while but one had been secured elsewhere. Scattered over the barren plains were little pyramids from which the sand was thrown up in jets by a hairless mole, which was only observed 200 miles from the coast. The hairlessness of this animal, *Heterocephalus glaber* Rüpp, is a unique feature among the rodentia. The specimen presented by Dr. Smith to the Academy is the only alcoholic preparation of the species known to exist and the second one on record in any form, the type being in the Senckenburg Museum.

Another specimen of unusual interest and variety is one of *Trilophomys imhausi* Milne Edw.—a maned rat covered with long, stiff hair, arranged in three longitudinal divisions. Its nearest affinities in externals and habits are to our marmots.

A *Colobus* or horse-tailed monkey occurred in troups of 500 or 600 and formed a very peculiar feature of the landscape. The skins are used by the natives to form bands for the ankles and knees. The species is the *guereza* of Rüppell. Guinea fowls were found plentifully wherever there was water, a beautiful vulturine form being of special interest. An infinite number of bee eaters were observed, especially about Lake Rudolf, where they were active in catching the insects driven up by the volcanic smoke.

The entire collection of mammals, which was commented on in detail by Mr. Samuel N. Rhoads, includes fifty genera and about seventy species represented by 200 specimens. Seven genera and twelve species are new to American museums. This portion of Dr. Smith's gift is of special interest and value, as the mammals alone have not been examined and described by specialists elsewhere. Mr. Rhoads also spoke of the fishes and reptiles. The batrachia embrace 40 species of 18 genera, mostly new to the Academy.

Mr. Witmer Stone spoke of the collection of birds which had been determined by Mr. Bowdler Sharp, of the British Museum. The portion presented to the Academy consists of 150 specimens of about 100 species, fully one-half new to the museum. A new species of *Turacus* was found in the darkest portion of the inland forest and had been named in recognition of the discoverer's distinguished services to science.

Dr. Henry Skinner stated that the insects included 871 specimens; the distribution in the several groups was noted. A report on the diptera was made by Mr. Chas. W. Johnson, and Mr. Wm. J. Fox spoke of the collection of hymenoptera consisting of 160 specimens, all of which were new to the Academy's cabinet, eight being of undescribed species.

There were but few mollusks, but on those which were presented, Mr. Henry A. Pilsbry based some remarks on the molluscan fauna of Africa and its geographical distribution.

The entire collection is probably the most extensive and important yet brought from Africa by an individual explorer, and the portions so generously given to the Academy by Dr. Smith form a valuable addition to its resources.

Mr. Henry A. Pilsbry spoke of the geology of the deposit containing fossil *Unionidæ* at Fish House, New Jersey. The mussels, some twelve species of *Unio* and *Anodonta*, occur in a thick black clay stratum used for brick and tile making. Below this is a stratum of red clay, gravel and 'ironstone' (bog iron), about two feet thick, which rests on a bed of sand of unknown depth. This sand shows the stratification and oblique lamination characteristic of arenaceous deposits in running water. The speaker considered that the hypothesis of an ancient 'oxbow' of the Delaware river explained the phenomena presented, the underlying sand having been deposited in the bed of the river; the channel was then abandoned for a new one, leaving a lagoon or 'slough,' in which the layer of yellow material was deposited at subsequent times of freshet, and after the up-stream end of the lagoon was entirely filled up, the black clay was formed in idle water, largely by the decay of organic matter, molluscan and other life flourshing in lagoons of this nature. Mr. Pilsbry held that the black clay and underlying sand was a deposit wholly different in genesis and earlier in time than the gravel which overlies the clay bed, this last gravel being referred by Prof. Salisbury to the Pensauken formation. Besides the mussels, fossil wood occurs in the black clay, as well as remains of the pleistocene horse, *Equus major* Leidy, determined by Prof. Cope.

The latter, as well as the Unionidæ (some of which are recent species), prove the deposit to be of post-pliocene age, instead of cretaceous, as claimed by Dr. Lea, Prof. Whitfield and some others. The character and age of these deposits were further considered by Messrs. Woolman and Heilprin.

A paper entitled 'The Planktonokrit, a centrifugal apparatus for the volumetric estimation of the food supply of oysters and other aquatic animals,' by Chas. S. Dolley, M. D., was presented for publication.

EDWARD J. NOLAN,
Recording Secretary.

PROCEEDINGS OF THE TORREY BOTANICAL CLUB, MAY 12, 1896.

AT the regular meeting, owing to the absence of the President and both Vice-Presidents, Dr. N. L. Britton and afterwards Mr. L. G. Fay occupied the chair. Dr. A. Schneider acted as Secretary.

One nomination for membership was received and the following communication was read and recommended to be placed on the minutes:

Secretary Torrey Botanical Club:

DEAR SIR: I have the honor to inform you that Mr. Edward Berry has presented the Torrey Club with fifty fine specimens of plants from the country about Passaic, N. J., and other counties of the same State. They will be mounted and placed among the other specimens in the herbarium as soon as opportunity offers. I remain, sir.

Very respectfully yours,
HELEN INGERSOLL,
Curator.

Mr. A. A. Tyler read his paper on 'A historical Review of the Study of Stipules.' He presented briefly the older opinions in regard to the morphology and modification of stipules. The paper was discussed by Dr. Britton and others. Mr. Tyler subsequently made further remarks on the origin and development of stipules.

The paper entitled 'Appendages to the Petioles of Liriodendra' by Mr. Arthur Hollick was read by title, owing to the absence of the author.

Meeting adjourned.

W. A. BASTEDO,
Secretary pro tem.

ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

THE sixth annual meeting of the Alabama Industrial and Scientific Society was held in Birmingham, Ala., on May 13th; eighteen members present. On account of the death of the President, Mr. Thos. Seddon, the Vice-President, Mr. F. M. Jackson, presided. Papers were read before the Society, as follows:

'On the Manufacture of Steel in the Birmingham District,' by Paschal G. Shook; 'On the Grading of Coke Iron, with special reference to the Birmingham District,' by W. H. Brannon; 'On the Grading of Coke Iron,' by Dr. Wm. B. Phillips; 'On Gold Mining in Alabama,' by Wm. M. Brewer; 'On the Coal Washer used at Brookwood, Ala.,' by F. M. Jackson. A paper by Jno. S. Kennedy, of Chambersburg, Pa., on 'Blast Furnace Flue Dust,' was read by title in the absence of the author.

Steps were taken to provide for the collection and publication, monthly, by the Society, of the statistics of coal and iron production in Alabama. Twelve new members and the officers for the current year were elected. These officers are: President, F. M. Jackson; Vice-Presidents, Jas. H. Fitts and Jos. Squire. The Society then adjourned to meet again in November.

EUGENE A. SMITH,
Secretary.

NEW BOOKS.

Publications of the Washburn Observatory of the University of Wisconsin. Vol. IX. Part I. Investigation of the Aberration and Atmospheric Refraction. By GEORGE C. COMSTOCK. Part II. Determinations of Right Ascension. By ALBERT S. FLINT. Madison, Wis. 1896.

Artistic and Scientific Taxidermy and Modelling. MONTAGU BROWNE. London, Adam and Charles Black; New York, Macmillan & Co. 1896. Pp. xx+467. $6.50.

Ice Work, Present and Past. T. G. BONNEY. New York, D. Appleton & Co. 1896. Pp. xiv+205. $1.50.

Erratum: In the article by Prof. O. C. Marsh on *The Ape-man from the Tertiary of Java,* page 792 above, four lines were misplaced by the printers in inserting the illustrations. The last line of the first column and the first three lines of the second column should follow the fourth line of the first column.

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CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

WEISMANN ON GERMINAL SELECTION.

This last contribution of Prof. Weismann to his system of inheritance and evolution hypotheses was presented to the International Congress of Zoölogists at Leyden last September. It was published in German at the beginning of the current year, and has just appeared in English as No. 19 of the Religion of Science Series (Open Court Publishing Co., Chicago).

It is evident from many expressions throughout the paper that Prof. Weismann considers this one of the most important of all his contributions on the evolution problem, and even those who cannot accept this most advanced and in some respects most speculative of all his hypotheses will nevertheless be inclined to regard the paper as important in marking some fundamental changes in Weismann's position.

During the long continued discussion between Weismann, Spencer and others there was a feeling in certain quarters that something was wrong with the methods employed and that the deadlock of opinion could not be broken by inductive reasoning alone. Weismann's present paper, however, gives evidence that many of the objections raised by his opponents have taken deep hold upon him, and have, in fact, convinced him that his former position was untenable. "The real aim of the present essay," says Weismann, "is to rehabilitate the principle of selection. If I should succeed in reinstating this principle in its emperilled rights it would be a source of extreme satisfaction to me." To hear the author of 'Die Allmacht der Naturzüchtung' speak of 'rehabilitating' and 'reinstating' the principle of selection betokens a revolution of opinion scarcely less sudden and wonderful than that manifested in a certain historic conversion on the way to Damascus.

In this paper Weismann expressly makes the following concessions: 1. "The principle of panmyxia is not alone sufficient for a full explanation of the phenomena (of degeneration). My opponents in advancing this objection are right to the extent indicated and as I expressly acknowledge." 2. "The Lamarckians were right when they maintained that the factor for which hitherto the name of natural selection had been exclusively reserved, viz., *personal* selection, was insufficient for the explanation of the phenomena" (of the disappearance of useless parts). 3. "The fact of a simultaneous, functionally concordant yet essentially diversified modification of numerous parts points conclusively to the circumstance that *something is still wanting to the selection of Darwin and Wallace which it is obligatory on us to discover if we possibly can*, and without which selection as yet offers no complete explanation of the phyletic processes of transformation. There is a hidden secret to be unriddled here before we can obtain a satisfactory insight into the phenomena in question. *We must seek to discover why it happens that the useful variations are always present.*"

These are most fundamental concessions, yet it must not be supposed that they necessarily lead to the Lamarckian position. The insufficiency of natural selection to explain all the phenomena of phyletic transformation Weismann attributes to the fact that this principle has been unduly limited in its field of operation; it has heretofore been regarded as applicable only to *persons;* it should be considered as applicable to every organic unit, whether visible or invisible, even down to the hypothetical biophores.

Natural selection occurs among all orders of individuality, colonies, persons, organs and tissues, determinants and biophores, and corresponding to these different units Weismann recognizes "three principal stages of selection: That of *personal* selection as it was ennunciated by Darwin and Wallace; that of *histonal* selection as it was established by Wilhelm Roux in the form of a 'struggle of the parts,' and finally that of *germinal* selection whose existence and efficacy," he says, "I have endeavored to substantiate in this article—these are the factors which have cöoperated to maintain the forms of life in a constant state of variability and to adapt them to their conditions of life." In brief, natural selection is still omnipotent if only it be regarded as omnipresent.

Germinal selection consists in an extension of this principle of selection to the determinants and biophores and it may be reduced to the following propositions:

1. "Every independently and hereditarily variable part is represented in the germ by a determinative group of vital units, whose size and power of assimilation correspond to the size and vigor of the part."

2. Variations in the size of determinants (some being larger, some smaller and some the same size as the maternal determinants) are caused by 'the inevitable fluctuations of the nutritient supply.' *The ultimate cause of all inherited variations in size is, therefore, to be found in the influence of nutrition on the determinants.*

3. The *quality* of a determinant depends upon the numerical proportion of the biophores which it contains. If that proportion is altered so also is the *character* of the determinant. The struggle for nutriment, with its subsequent preference of the strong-

est, must take place between the various species of biophores as well as between the species of determinants. By the continued weakening of a biophore until it ultimately disappeared the quality of the determinant to which it belonged would be changed. *The ultimate cause of all variations in kind is, therefore, due to the varying amount of nutriment supplied to the biophores.*

4. "Every determinant battles stoutly with its neighbors for food."

5. The weaker determinant "will be unable to obtain the full quantum of food * * * * and the result will be that its progeny will be weakened still more * * * and inevitably the average strength of this determinant must slowly but constantly diminish."

6. The stronger determinants "oppose a relatively more powerful front to their neighbors, that is, actively absorb more nutriment, and upon the whole increase in vigor and produce more robust descendants."

7. The plus and minus variations may go on simultaneously and independently in many groups of determinants. When in any case they have reached selection value they may be checked or increased by personal selection. "In this manner it becomes intelligible how a large number of modifications, varying in kind and far more so in degree, can be guided *simultaneously* by personal selection."

The possible application of some of these principles is illustrated by cases of mimicry shown in the wings of butterflies, and the necessity of retaining the principle of natural selection to explain mimicry and adaptations in general is ably shown. In conclusion the author says: "We had applied the principle of natural selection to a part of the natural units engaged in struggle. If we apply the principle throughout we reach a satisfactory explanation. Selection of *persons* alone is not sufficient to explain the phenomena; *germinal* selection must be added. Germinal selection is the last consequence of the application of the principle of Malthus to living nature." * * * "This proposition seems to me to round off the whole theory of selection and to give it that degree of inner perfection and completeness which is necessary to protect it against the many doubts which have gathered around it on all sides like so many lowering thunder clouds."

Regarding Weismann's recent concessions to his opponents, it should be observed that he does not make them until having gotten a new foothold on the principle of germinal selection he can afford to yield these points. He nowhere makes adequate acknowledgment of the force of the facts urged against natural selection, nor the insufficiency of the latter until he feels sure that he can save his pet theory by another theory. In short, it would appear that with him the all-sufficiency of natural selection is a foregone conclusion, and however weighty the arguments may be which are brought against his position he disregards them until he is able to explain them in conformity with his theory.

This new hypothesis of germinal selection is a bold attempt to explain the causes of *all* variations and the usefulness, or adaptive character, of many variations upon the selection principle. With such high aims it is an extremely important contribution, whatever may be thought of its probability. To the writer it seems that Weismann fails to recognize that the 'selection' which he predicates of determinants and biophores is a wholly different principle from the natural selection of Darwin and Wallace. Both natural and artificial selection signify that in the struggle for existence certain individuals and races are *selected* and others *rejected*. If the unfit should survive and leave as many offspring as the fit there would certainly be no such thing as natural selection. Germinal selection, however, signifies that certain germinal units grow larger through increased nutrition; that this purely acquired character is transmitted to their descendants, and that these stronger determinants leave no *more* progeny, but simply *stronger* progeny; the weaker determinants leave no *fewer*, but simply *weaker* descendants. In short, the process is wholly and simply the continued inheritance of an acquired character. In the whole process there is no *selection* or *rejection*, but merely a continuance of individual determinants with the transmission of characters acquired by them to their descendants. How very different this is from the usual meaning of the term *selection* Professor Weismann, perhaps better than any other, could explain.

As to the evidence for germinal selection Weismann frankly avows that he "can adduce nothing except that it is at present the only explanation that can be given," and in this regard it should be observed that it stands upon a distinctly different basis from *personal* selection or *histonal* selection, each of which is directly supported by a very large number of observations and is a legitimate deduction from the facts, whereas germinal selection is confessedly merely an inductive speculation.

Evidence should be the crucial test for this as for any theory, and yet it is at this very point that it is weakest. Not a particle of evidence is adduced in proof of a single proposition named. Apart from the fundamental conception of determinants, which is still a mere matter of speculation and upon which the gravest doubts exist in the minds of many eminent men, some evidence may be adduced against certain of the propositions named:

1. The idea that the size of a determinant corresponds to the size and vigor of the part to which it gives rise, or the *determinate* as Weismann calls it, is neither a necessary conclusion nor indeed a highly probable one. If space permitted, much evidence might be brought forward, based on a study of precocious development and larval organs, to show that the size of the cell or region of the egg which gives rise to a certain part does not generally correspond to the *size* of the part, but rather to the *time* of its formation. To be sure cells and regions of the egg are not determinants in Weismann's sense, but they are frequently the *Anlagen* of organs, and as such are the nearest approach to the determinants of Weismann which may be recognized by observation. Judging the unseen therefore by the seen, there is a certain amount of evidence that the longevity of a determinant and the rapidity of the transformations which it is able to undergo, rather than its size, stands in direct relation to the size and vigor of the determinate, and it may well be that the simpler and smaller determinants, and not the larger ones, possess the greatest stability and longevity.

2. "Every determinant battles stoutly with its neighbors for food." I suppose Professor Weismann must regard this as a mere figure of speech, in fact not only the battle and the means of warfare, but the combatants and the cause of battle must all be figurative, as they are all imaginary. But what evidence or probability is there that there is not food enough for every determinant to live on and grow fat? Do the determinants increase in geometrical ratio; does each species require a different kind of food, and must we after all suppose that with divine prescience nature has taken care to supply less food to the determinants than they need in order that they may battle with each other? Such questions are asked in good faith, though one shrinks from asking them lest he may be classed by Weismann with 'the hotspurs of biology, who clamor to know forthwith how the molecules behave, * * * * * * * forgetful that all our

knowledge is and remains throughout provisional.' But inasmuch as Weismann has undertaken to teach us 'just how the molecules behave,' and since this is the *only* aim of his essay, it would seem that all such clamorings are entitled to some recognition. Unless the food of determinants is 'Ein ganz besonderes Saft,' one would think that the soma might be able to supply it in quantities large enough to cause the hungry determinants and biophores to stop their fighting. In all seriousness, it seems to me that to class such a purely figurative and imaginary 'struggle' along with Darwin's principle, as Weismann does, is to wholly disregard the importance of evidence.

3. The greatest objection to the all-sufficiency of natural selection, which Weismann, along with many others, recognizes, is 'the fact of a simultaneous, functionally concordant yet essentially diversified modification of numerous parts.' This objection Weismann thinks he has removed by assuming that the determinants may vary simultaneously and independently, and may increase or decrease in size through germinal selection. This does remove some of the difficulties; it furnishes, *ex hypotheso*, the individual variations for personal selection, but the one great difficulty remains untouched, viz., the *combination* of these individual variations into a functionally concordant system. This difficulty, which is really the only important one in this connection, remains just where it was before Weismann proposed his doctrine of germinal selection.

Weismann ably argues that there is in certain quarters an evident tendency to under-estimate the relative importance of theories as compared with facts, and he points out the great value of having symbols or mental images of natural processes, even though these symbols may not correspond to reality. Whether there are any such things as biophores, determinant, germinal selection and the like, or not, it is at least evident that a mental symbol is better than mental vacuity, and that to have conceived a process by which the details of evolution and inheritance can be explained, even if it be a false conception, is better than no conception at all. Prof. Weismann is right when he says that there is no just cause for criticism of his system on the ground that it is purely imaginary, *provided it is always so treated and understood.* It is only when he says that certain imaginary processes *must be so*, as he does in this as well as in former essays, that it is pertinent to remind him that we are dealing, not with a system of necessities, but only with a series of mental images, each one of which may or may not correspond to reality.

I think it may well be doubted whether such speculations are at present the most profitable method of approaching the problems under discussion. Induction and the test of conceivability are distinctly inferior as scientific instruments to observation, experiment and deduction. Speculation is valuable only as it is verified by observation and experiment and while the solution of such recondite problems must be approached from all possible sides, yet it may be doubted whether it is more profitable for one to continue to start more speculations than a whole generation can run down rather than to take part in hunting down and verifying or rejecting his own speculations.

E. G. Conklin.

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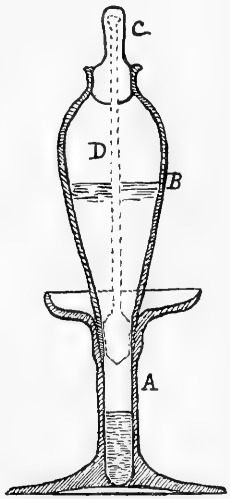
THE SMEETH SEPARATING APPARATUS.

The tube devised by Harada for using heavy liquids in separating the mineral constituents of rocks has been modified by Broegger, so as to obviate difficulties arising from the adherence of light and heavy particles desired to be separated. This apparatus is more or less cumbersome and fragile on account of the stop-cocks it contains.

It appears to me that the separating tube proposed by Smeeth (Proceedings of the Royal Dublin Society, May, 1888, p. 58) has not been fully appreciated. The principle involved seems to be an excellent one, and by modifying the shape somewhat it can be much improved. With this end in view, several of the tubes were made by Eimer & Amend, of New York, after the design indicated in the accompanying figure. The apparatus consists of a cup-shaped base, A, with a hollow standard,



the tube B, to contain the heavy liquid in which the separation takes place, the stoppers C and D to close respectively the upper and lower ends of this tube. All of these separate parts have ground fittings, so as to be water-tight. The tube is so simple that no special explanation of the method of using it is needed. It will be seen that when the two stoppers, C and D, are out, it affords an opportunity to stir both the material which has sunk to the bottom of the tube of the standard A, as well as that which floats upon the top of the heavy liquid in B, and by repeating the process several times it is possible to easily secure a complete separation.

It will be readily seen, also, that by inserting the stopper D, the tube B, with its contents of heavy liquid and light material floating on its top, can be removed. The heavy material can then be washed out of A, leaving this heavy material entirely separated in the standard A.

This apparatus, besides the advantage already enumerated, is especially stable and portable, and all the material during the separation is free from exposure to the air, features which give its great advantage in laboratory work. J. S. DILLER.

U. S. GEOLOGICAL SURVEY.

CURRENT NOTES ON PHYSIOGRAPHY.

VALLEYS OF THE OZARK PLATEAU.

THE account of the Ozark mountains recently published by Keyes (see SCIENCE, Feb. 21, 1896) is followed by a valuable essay from O. F. Hershey on the valleys of the same region (Amer. Geol., xvi, 1895, 338–357); the conclusions of the two observers agreeing in general as to processes of land sculpture, but differing somewhat as to geological dates at which various stages of the work of denudation were reached. A lowland peneplain has been uplifted to form the Ozark plateau; it is deeply dissected around the margin, so that the dissevered hills are not inappropriately called 'mountains.' The ancient lowland is called a Tertiary peneplain by Keyes, and a Jura-Cretaceous peneplain by Hershey. The latter describes certain broad and shallow valley-troughs, slightly depressed beneath the general upland, as the work of Tertiary time in the gently uplifted Cretaceous peneplain. He concludes that the meandering courses of the narrow young Pleistocene valleys are inherited from similarly curved courses on the flat floors of the old Tertiary valley-troughs in which the young valleys are incised; while the relative straightness of the Missouri is ingeniously explained as a consequence of its comparatively recent entrance into this region, after uplift in the region of the great plains.

COASTAL DESERT OF PERU.

MAJOR A. F. SEARS describes the coastal desert of Peru in a recent Bulletin of the American Geographical Society (xxvii., 1895, 256–271). The desert belt has its greatest width near latitude 5° S., where it measures about 120 miles to its inner margin, 1,000 feet high along the base of the western Cordillera; thence narrowing southward but extending about 2,000 miles along the oblique part of the South American coast. The surface is barren, except along the few river courses; crescentic dunes, or *médanos*, frequently occur; the drifting sand produces a sighing sound, like that from a forest under the wind. From December to March winds set on shore and give some rain to the Cordillera (apparently 'subequatorial rains'); then the rivers flow again, after having withered in the dry season. A graphic description is given of the 'coming of the river' in the case of the Piura. In February or March, when it is expected, travelers from up the valley are anxiously asked about its advance. When it is near the town of Piura, parties go out to welcome it with music and fireworks, returning with its trickling advance over the dry sandy bed. Thousands greet its arrival at the city. Excellent cotton is produced in the valley, and the crop might be much extended by systematic irrigation; but most of the water in the rising river is allowed to waste itself in the sea. Once in from five to seven years rain falls on the plain; then it is soon covered with grass and flowers, and cattle wander out of the valleys for a time; but in a few weeks all is barren again.

LAKES IN THE SAHARA NEAR TIMBUKTU.

THE great northward curve of the Niger carries its fertile flood plain into the border of the Sahara, where Timbuktu stands near the margin of the upland in a region of sand dunes alternating with stunted forests. The wet season comes with the equatorial rains from June to August; but high water in the river is delayed until January, as if determined by rains about the more southern head branches. The river then overflows its broad flood plain, above which the villages stand on sand dunes. French occupation has brought to light several lakes that occupy depressions between spurs of the desert upland, which rises in abrupt rocky slopes a hundred meters above their waters. The largest, Faguibine, is about 60 kilometers north of the river and west of Timbuktu; it is 110 kilometers in length and over 30 meters deep; almost comparable, therefore, with Lake Chad. It is fed by a flooded distributary of the Niger during high water; in the dry season a current sets back again from the lake to the river. Debo is a somewhat smaller lake, apparently lying on the flat flood plain of the great river, 120 kilometers southwest of Timbuktu (Bluszet, La région de Tombouctou, Bull. Soc. géogr. Paris, xvi., 1895, 375–388).

Unless gratuitously explained by local subsidence, Faguibene may perhaps be regarded as one of those lakes that stand in a lateral valley near its junction with a main valley along which a great river has been actively building up a heavy flood plain.

PHYSIOGRAPHY OF MONTENEGRO.

A RECENT supplement to *Petermann's Mitteilungen* consists of 'Beiträge zur physischen Geographie von Montenegro,' by K. Hassert, *privatdocent* in Leipzig, giving a very serviceable account of this rugged and out-of-the-way country. Successive chapters treat the previous studies, geological structure, surface form, landscape, springs and rivers, lakes, climate and plants. Special attention is given to the karst district of limestone understructure and subterranean drainage; the peculiar topography thus controlled being so fully developed that a considerable series of special terms is required to name its various features. Although having a plentiful rainfall, the karst surface suggests aridity by reason of the scantiness of soil and the frequent exposure of bare rock; and the loose-lying limestone blocks have not been without influence on the course of local history in furnishing ammunition for the 'stone batteries' with which Montenegrins on the valley sides have harrassed the Turkish invaders in the defiles below. The uplands are frequently dissected by deep canyons, which greatly impede travel and trade; but the people have by long practice become expert in shouting across the chasms, thus sending both public and private messages.

Scutari lake, seldom over twenty feet deep, is explained as a limestone lowland, or *polje*, whose outward drainage is obstructed by the alluvial deposits of the river Drin.

As is often the case, the treatment of the different chapters is uneven. Careful discussion of origin is given to the forms of the limestone region; much less attention is given to such problems as the location of stream courses and the attitude of divides; an inward migration of the latter is strongly suggested by the short course of the Bojana system to the Adriatic and the long course of the Danube branches to the Black sea.

W. M. Davis.

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CURRENT NOTES ON METEOROLOGY.

INTERNATIONAL CLOUD STATIONS.

The following is a complete list of the stations which are now taking cloud observations with photogrammeters, and theodolites, in connection with the scheme to be followed throughout the International Cloud Year, which has been extended until August 1, 1897. Paris; Upsala; Potsdam; Braunschweig; Danzig; St. Petersburg; Nijni-Novgorod (in summer); Batavia, Manila, and Sydney, N. S. W. The following stations are taking observations with theodolites: Washington, D. C.; Blue Hill Observatory, Readville, Mass.; Bossekop (in summer); Dorpat; Tiflis; Ekatherinenburg; Irkutsk. There will probably also be a second station in Australia, one in India and one at Lisbon.

ILLUSTRATIONS OF CLOUD TYPES.

In connection with its work on clouds already referred to in Science, the Weather Bureau has issued a sheet giving illustrations of the typical cloud forms. The accompanying text contains descriptions of the clouds, and also data as to their mean heights and velocities. The sheet was prepared as an aid to observers in their cloud work. Most of the types selected are good, and the reproductions excellent as a whole. The alto-stratus and stratus are, however, unsatisfactory. The International Cloud Atlas, which has just been issued, gives us the cloud types selected by the International Cloud Committee, and these will, of course, now be the standard for the world.

THE ST. LOUIS, MO., TORNADO OF MAY 27.

With commendable promptness the Weather Bureau issued on May 29, a special *Storm Bulletin* (No. 4 of 1896), showing the weather conditions over the United States on May 26–28, in connection with which the severe tornado of May 27th occurred at St. Louis. The Chicago 8 A. M. forecast on May 27th predicted severe thunder storms for Illinois, Indiana and Missouri during the afternoon and night, and a special warning was sent out from Washington at 10:10 A. M.

CLIMATE OF THE FALKLAND ISLANDS.

IN a recent account of the Falkland Islands (Scot. Geogr. Mag., May, 1896, 241–252) mention is made of a striking effect of the high winds which are characteristic of the higher latitudes of the South Temperate Zone and are a marked feature of the climate of the Falklands. Owing to their being obliged constantly to beat against these violent winds, the inhabitants have acquired a peculiar gait that is so noticeable as to have gained for them the name of 'kelpers,' which is sometimes used as synonymous with 'natives.' R. DE C. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

RACIAL ELEMENTS IN ASSAM.

IN the *Times* of Assam, February 8, 1896, Mr. S. R. Peal gives the results of his extensive studies of the racial constitution of the Assamese people. The aboriginal inhabitants he believes to have been Dravidian, though at present he would not assign more than five per cent. to that element. They were overlaid by the intrusive Mon from the east, a monosyllabic stock, who in time were followed by a small invasion of Tibetans. All of these were weak and of low culture. The Hindu religions, the Aryan physique and the prevailing tongue were introduced by the immigration of Sanskrit-speaking conquerors at a remote epoch. They left such a profound impress on the earlier population and the existing Assamese language that Mr. Peal says of it: "With the exception of the Bengali, there is probably no derivative from the Sanskrit that bears a closer affinity to its parent." This was the extreme limit of the wave of Aryan migration which swept eastward across Bengal. The conquering Ahoms, from Siam, who in later centuries gained temporary control of Assam, exerted little permanent influence on its civilization or language.

THE TUPI LINGUISTIC STOCK.

THE eighteenth volume of the Bibliothèque Linguistique Américaine (Maisonneuve, Paris), which has just appeared, is a valuable member of the series. It presents the elements of a comparative grammar of the dialects of the Tupi linguistic stock of South America, prepared by the able pen of M. Lucien Adam, to whom we owe so many analyses of American tongues. The southern Tupi is known as the Guarani; and the 'Lingoa Geral,' spoken throughout Brazil, is a corrupt form of the same idiom. The stock is widely diffused, extending from Paraguay to Guiana, and for thousands of miles along the Amazon and its tributaries. Its literature is quite extended, the bibliography of it published in 1880 by Valle Cabral, numbering over three hundred titles.

M. Adam presents an analysis, carried through the principal dialects, of the phonetic laws of the stock, the expressions of the relations of possession and action (genitive and nominative), the pronouns, and an elaborate study of the conjugation. A comparative vocabulary with 358 titles is an extremely useful appendage.

The collation of the literature which he has utilized includes most of the best works, but I regret not to see included the excellent studies on the Neengatu of the late Mr. C. F. Hartt.

D. G. BRINTON.

SCIENTIFIC NOTES AND NEWS.

THE COLORS NAMED IN LITERATURE.

MR. HAVELOCK ELLIS has made (*Contemporary Review*, May) an interesting study of the color terms used by imaginative writers, which is a real contribution to scientific æsthetics. The fact that the Greeks did not name green and blue does not, of course, indicate (as Mr. Gladstone and others have alleged) that they could not see the more refrangible rays of the spectrum, but it does show a lack of interest in

	White.	Yellow.	Red.	Green.	Blue.	Black.	PREDOMINANT.
Mountain Chant	28	13	3	...	19	37	Black, white.
Wooing of Emer	34	3	48	...	...	14	Red, white.
Volsunga Saga	14	...	71	...	14	...	Red.
Isaiah, Job, Song of Songs	18	4	29	33	...	15	Green, red.
Homer	21	21	7	2	...	49	Black, white-yellow.
Catullus	40	21	17	9	4	8	White, yellow.
Chaucer	34	10	28	14	1	13	White, red.
Marlowe	19	21	19	6	6	28	Black, yellow.
Shakespeare	22	17	30	7	4	20	Red, white.
Thomson	9	...	18	27	9	36	Black, green.
Blake	17	17	13	16	7	29	Black, white-yellow.
Coleridge	21	7	17	25	14	16	Green, white.
Shelley	17	19	11	21	21	11	Green-blue.
Keats	14	23	24	29	8	1	Green, red.
Wordsworth	14	18	10	35	11	12	Green, yellow.
Poe	8	32	20	12	4	24	Yellow, black.
Baudelaire	11	9	19	10	16	34	Black, red.
Tennyson	22	15	27	15	10	11	Red, white.
Rossetti	30	22	22	9	7	10	White, yellow.
Swinburne	28	18	28	16	6	4	Red, white.
Whitman	25	10	26	14	8	16	Red, white.
Pater	43	19	11	11	9	7	White, yellow.
Verlaine	20	15	24	9	14	18	Red, white.
Olive Schreiner	38	12	25	3	19	2	White, red.
D'Annunzio	15	11	46	7	14	6	Red, white.

these colors. Mr. Ellis's statistics are given in the above table, the number of times each of the colors is used by the author in selected passages being reduced to percentages.

Mr. Ellis makes a number of acute psychological and literary suggestions and concludes that a numerical study of color vision "possesses at least two uses in the precise study of literature. It is, first, an instrument for investigating a writer's personal psychology, by defining the nature of his æsthetic color vision. When we have ascertained a writer's color formula and his colors of prediction we can tell at a glance, simply and reliably, something about his view of the world which pages of description could only tell us with uncertainty. In the second place, it enables us to take a definite step in the attainment of a scientific aesthetic, by furnishing a means of comparative study. By its help we can trace the colors of the world as mirrored in literature from age to age, from country to country, and in finer shades among the writers of a single group. At least one broad and unexpected conclusion may be gathered from the tables here presented. Many foolish things have been written about the 'degeneration' of latter-day art. It is easier to dogmatize when you think that you are safe from the evidence of precise tests. But here is a reasonably precise test. And the evidence of this test, at all events, by no means furnishes support for the theory of decadence. On the contrary, it shows that the decadence, if anywhere, was at the end of the last century, and that our own vision of the world is fairly one with that of classic times, with Chaucer's and with Shakespeare's. At the end of the nineteenth century we can say this for the first time since Shakespeare died."

GENERAL.

PROF. E. D. COPE has been elected an honorary member of the Academy of Sciences of Belgium.

Nature gives the following details regarding the approaching celebration of Lord Kelvin's jubilee as professor of natural philosophy in the University of Glasgow: On the evening of Monday, June 15th, at 8:30 p. m., the University will give a conversazione, when there will be an exhibit of Lord Kelvin's inventions. On Tuesday, June 16th, addresses will be presented to Lord Kelvin by delegates from home and foreign university bodies, from several of the learned Societies of which he is a member, from student delegates from other universities, and from the students and graduates of the University of Glasgow. It is expected that the honorary degree of LL.D. will be conferred on the same day on several of the distinguished foreign visitors. On Tuesday evening, June 16th, the City will give a banquet to Lord Kelvin, to which the visitors who have come to do him honor have been invited. On Wednesday, June 27th, the Senate of the University will invite the visitors of the University staff to sail down the Clyde. The students of the University also invite the students' delegates from other universities to a similar trip. Representative scientific men—about fifty in number—from America and the British colonies, and from all the European countries, and about 150 from the United Kingdom, have signified their intention to be present.

IN addition to the expeditions from Amherst College and from the Lick Observatory, University of California, parties are on their way from London and Paris to observe the eclipse of the sun from Japan. The English party includes the Astronomer Royal, Prof. Christie, Prof. Turner, of Oxford, and Captain Hills, of the Royal Engineers. M. Deslandres has charge of the French expedition.

THE Mayor of Bristol, at the instance of a deputation representing University College, Bristol, and other scientific institutions of the city, has invited the British Association to meet at Bristol in 1898. The Association met at Bristol in 1836 and in 1875.

THE Executive Committee of the New York Zoölogical Society has decided to send Mr. Hornaday to Europe to inspect the zoölogical gardens of Germany, Belgium, Holland, France and England. A Scientific Council has been appointed consisting of the following members: William T. Hornaday, Chairman, Director New York Zoölogical Park; Madison Grant, Secretary New York Zoölogical Society; Prof. J. A. Allen, curator of mammalogy and ornithology. American Museum of Natural History; Frank M. Chapman, assistant curator; Prof. Henry F. Osborn, Da Costa professor of zoölogy, Columbia University; Prof. Gilman Thompson, University of New York; Dr. Tarleton H. Bean, Superintendent New York Aquarium; Dr. George Bird, Grinnell, editor *Forest and Stream;* and William A. Stiles, Park Commissioner and editor of *Garden and Forest.* The Sinking Fund Commission of New York, authorized by the Legislature to set aside land for the Gardens of the Society, has postponed action on the application of the Society for the use of 261 acres of land in Bronx Park. Mayor Strong, it appears, is opposed to granting the land.

PROF. R. S. WOODWARD, Prof. R. H. Thurston and Judge Arthur P. Greely have consented to act as judges in the competition for prize essays on 'The Progress of Invention during the past fifty years,' proposed by the *Scientific American.*

WE learn from *Natural Science* that the following changes have recently been made on the staff of the British Geological Survey: A. Strahan, to be geologist on the English branch, in place of J. R. Dakyns, who has retired after 34 years' service; C. T. Clough, to be geologist on the Scottish branch, in place of the late Hugh Miller. The gentlemen are succeeded as assistant geologists by Mr. T. Crosbee Cantrill, B. Sc., and Mr. E. H. Cunningham-Craig, in England and Scotland respectively. Dr. Molengraaf, of Amsterdam, whose work in South African geology is well known, has been appointed State Geologist by the Transvaal Government.

THE *British Medical Journal* for May 23d is a special number commemorating the Jenner Centennial, being entirely filled with interesting accounts of Jenner and the subsequent progress of vaccination.

DR. BASHFORD DEAN, Messrs. Calkins, Harrington, Griffin and a number of students from Columbia University are about to start for Port Townsend, Washington, and will spend the summer in study and research on Puget Sound.

THE Brooklyn Institute has undertaken to collect $3,000 for the purchase of the William Wallace Tooker collection of Indian relics.

THE New York University has conferred the degree of LL.D. on Prof. I. C. Russell, of the class of 1872, professor of geology in the University of Michigan.

PROF. ALBERT S. BICKMORE, of the American Museum of Natural History, has gone to the West Indies to collect materials for a course of lectures for teachers, to be delivered in the Museum in the autumn. Mr. Dwight L. Elmendorf is already in the Windward Islands, taking photographs for the illustrations of the lectures. The expenses of the trip will be paid by the State, and copies of these lectures will be furnished to the public schools in the seventy principal cities and villages of the State.

PROF. MAX MÜLLER was made a Privy Councillor on the Queen's birthday. It is said that Huxley is the only man of science previously admitted to the Council in recognition of scientific work.

SENATOR MORRILL, from the Committee on Finance, made on June 4th a favorable report on the joint resolution authorizing the Secretary of the Treasury to have made a scientific investigation of the fur-seal fisheries.

GERHARD ROHLFS, traveller and explorer, died on June 3d, at Godesberg, Prussia, aged 62.

THE daughters of Carl Marx are collecting material for a biography of their father.

ON the evening of May 19th Prince Henry of Orleans delivered a lecture before the Royal Geographical Society, on his journey between Talifu (Yun-nan) and Sadiya (Assam). This is the shortest and most direct route from China to India. It was, however, traversed with great difficulty and is not practicable for trade.

PROF. L. L. DYCHE, of the University of Kansas, has gone to Alaska with a view to Arctic exploration.

AT a meeting of the Royal College of Surgeons, England, on May 14th the Walker prize was conferred on Mr. H. J. Stiles and the Jacksonian prize on Dr. A. A. Kanthack.

ON May 26th Prof. T. G. Bonney began a course of two lectures at the Royal Institution on 'The Building and Sculpture of Western Europe' (the Tyndall lectures). On 28th Mr. Robert Munro, Secretary of the Society of Antiquaries of Scotland, gave the first of two lectures on 'Lake Dwellings,' and on Saturday, May 30th Dr. E. A. Wallis Budge, keeper of the Egyptian and Assyrian antiquities, British Museum, began a course of two lectures on 'The Moral and Religious Literature of Ancient Egypt.' Prof. J. A. Fleming lectured on 'Electric and Magnetic Research on Low Temperatures.'

WE are glad to learn that the editor of *Appleton's Popular Science Monthly* has invited President Mendenhall to reply to the article in the June number by Mr. Herbert Spencer criticising the metric system.

THE Washington *Star* states that Major Powell, Engineer Commissioner of the District of Columbia, has applied to the President, through Gen. Craighill, Chief of Engineers, for the detail of an officer of the engineer corps for duty with the District government as an assistant to the Engineer Commissioner, to fill the vacancy caused by the detachment of Captain Gustav J. Fiebeger, recently appointed professor of military and civil engineering at the Military Academy.

DR. WILLIAM COLLINGRIDGE, medical officer of the port of London, has been appointed as the Milroy lecturer for 1897, before the Royal College of Physicians, of London.

DR. A. GUNTHER has been elected President of the London Linnean Society. The gold medal of the Society has this year been awarded to Prof. George James Allman.

PROF. DARCY W. THOMPSON, of the University of Dundee, who has been sent by the British government to investigate the condition of the fur seals on the Prybilov Islands, left Washington for Alaska on the 3d of June. He will be accompanied by a Canadian naturalist, Dr. Macoun. They will go to the Islands on the 'Albatross,' which leaves San Francisco about the middle of the month.

MR. CLARENCE B. MOORE, who may be addressed at 1321 Locust street, Philadelphia, has kindly offered to present to any incorporated historical or archæological society applying to him, his works on 'Certain Sand Mounds of Dual County, Florida;' 'Two Mounds on Murphy Island, Florida,' and 'Certain Sand Mounds of the Ocklawaha River, Florida.'

PROF. C. JORDAN, author of 'Traité des Substitutions,' 'Cours d' Analyse,' etc., expects to visit America the latter part of June. He intends to spend about three months in America, visiting mines and universities.

THE twenty-second annual meeting of the American Neurological Association was held at the College of Physicians, Philadelphia, on June 3d, 4th and 5th, under the Presidency of Dr. F. X. Dercum. The next meeting will be held at Washington, D. C.

THE party from Cornell University which will embark with Lieutenant Peary on the Kite is as follows: R. S. Tarr, professor of dynamic geology and physical geography; A. C. Gill, professor of mineralogy and petrography; J. A. Bonstell, assistant in geology; T. L. Watson, fellow in geology; E. M. Kindle, scholar in paleontology, and J. O. Martin, special student in entomology. It is the purpose of the party to make as thorough a geological study as is possible in five or six weeks, of the region near the Devil's Thumb, at the south end of Melville Bay and in addition to this to make collections of flora and fauna. Another party will also sail with Lieutenant Peary, under the leadership of A. E. Burton, professor of civil engineering, in the Massachusetts Institute of Technology. This party will land at the great Umanak Fiord. They will make pendulum observations, natural history collections and study the glacial phenomena. Lieutenant Peary himself will proceed north as far as Cape Sabine at the entrance of Smith Sound. He will also endeavor to explore Jones sound. He will be accompanied by Mr. Albert Operti, the artist, who will take casts of the Cape York natives for the purpose of making models for the American Museum of Natural History, New York.

IN connection with the the Millenial Celebration at Buda-Pesth the University conferred the following honorary degrees on May 13th: The degree of Doctor of Medicine on Prof. J. S. Billings, of New York; Sir. Joseph Lister, London; Prof. R. Virchow, Berlin; Prof. Than, Buda-Pesth; Prof. Anders-Retzuis, Stockholm; Prof. Guido Baccelli, Rome; Prof. Eduard Roux, Paris: The degree of Doctor of Philosophy, on Prof. P. Berthelot, Paris; Mr. Herbert Spencer, London; Lord Kelvin, Glasgow; Prof. W. Wundt, Leipzig; Prof. Max Müller, Oxford; Prof. Grimm, Berlin; Prof. Lajos Lóczy, Buda-Pesth; Prof. R. W. Bunsen, Heidelberg; Prof. J. Bryce, Oxford; Prof. W. R. v. Hartel, Vienna; Prof. Hugo Schuchardt, Graz.

IN the last part issued of Engle und Prantl's *Natürliche Pflanzenfamilien*, Prof. Britton has been honored by the dedication to him of another genus, *Brittonastrum*, Briquet, in the Family Labiatæ. There are six or seven species in the group, natives of the southwestern United States and Mexico.

PROF. J. J. THOMPSON was announced to give the Reade lecture at Cambridge University on June 10th, the subject being the Röntgen rays.

AT a meeting of the Paris Academy, on May 4th, M. Guinkoff stated that he had succeeded in photographing the retina. The experiments were made on himself, and he had obtained a photograph of the retina of his left eye with an exposure of two seconds. The process is not more trying to the patient than the ordinary examination with the ophthalmoscope and leaves a permanent record.

UNIVERSITY AND EDUCATIONAL NEWS.

THE University of Pennsylvania has received $100,000 from Mr. Alfred C. Harrison, and $10,000 each from Mr. John H. Converse, Mr. William P. Henszey and an anonymous donor.

AT a recent meeting of the Board of Regents of the University of Michigan reductions were made in some of the salaries, and several instructors were dismissed. A resolution was adopted that where any department has two or more full professors, only the senior by date of appointment shall at any time receive a salary of more than $2,500. Law and medical professors, if they practice their respective professions, are to receive $2,000, and if they do not, $2,500. The psychological laboratory has been discontinued for one year.

IT is expected that Rev. George L. Perin will succeed Rev. Orello Cone as President of Buchtel College. Dr. John Clarence Lee has been elected President of St. Lawrence University at Canton, N. Y.

FRANK L. MCVEY, Ph. D., has been appointed instructor in economics at the University of Minnesota.

MR. F. P. SHELDON, for the past six years instructor in plant taxonomy at the University of Minnesota, has tendered his resignation in order to devote his energies to the management of his private business affairs and the profession of the law. Mr. A. A. Heller, late fellow of Columbia College and well known for his exploring trips in South Carolina, Texas, Idaho and the Sandwich Islands, will succeed Mr. Sheldon and will act as curator of the growing herbarium of the University.

THE following fellows in the sciences have been appointed at Cornell University: Entomology, James G. Needham, now instructor in Knox College, Illinois; mathematics (traveling fellowship), Prof. Paul Arnold, University of California; geology, Thomas L. Watson; agriculture, Leroy Anderson; mechanical engineering, W. O. Amsler; electrical engineering, L. A. Murray.

THE incomes of most of the colleges of Cambridge and Oxford have been greatly reduced by the agricultural depression. During the last university year the sum of only £72,943 was divided among the heads and fellows of the various colleges, as compared with £111,000 in 1882. The amounts contributed by the colleges for university purposes has been again decreased.

DR. DONALD MACALISTER has compiled, at the request of Syndics of the University Press, a guide entitled: *Advanced Study and Research in the University of Cambridge*, giving a clear account of the admirable opportunities offered for advanced study and research at Cambridge. As has already been stated in this JOURNAL, students holding degrees from other universities or having an equivalent training may pursue studies at the university and after two years of residence are admissable to the regular degrees. The facilities for study and research at Cambridge and Oxford are equal to those of German universities, and should attract an equal number of American students.

DISCUSSION AND CORRESPONDENCE.

PROF. BIGELOW'S SOLAR-MAGNETIC WORK.

TO THE EDITOR OF SCIENCE: Prof. W. S. Franklin, in his review of Prof. Bigelow's solar-magnetic work (this JOURNAL, Vol. III., No. 74), has performed a duty for which all meteorologists and physicists must thank him; but the question may fairly be raised as to whether the tone and temper of the performance were such as ought to characterize a report of an examination of even alleged scientific work. As one of many who have been more or less familiar with Prof. Bigelow's work during the past five or six years, I have all along been puzzled by the obscurity of his statements and the fact that I was unable to gain any intelligent idea of his methods. There was a certain satisfaction in finding that others met with no better success, although no one could deny the tremendous importance of the results which he thought he had reached. For most people life is too short for going over all the details of work which is being done by others, and usually a complicated scientific hypothesis receives its confirmation from verified prediction rather than from an analysis of methods and material. But while others have been waiting for Prof. Bigelow's work to prove itself by the practical application of which it was alleged to be capable, it is gratifying to know that some one was overhauling it and endeavoring to ascertain the foundation principles upon which it rests. It is quite proper that this should be done, and Prof. Bigelow or his friends can object only to the manner in which the reviewer has expressed himself. It will be admitted that there is a chance that Prof. Bigelow knows what he is doing, difficult as it seems to be for him to show other people, and it is to be hoped that he will not find in the unnecessarily harsh language of the review an excuse for ignoring it, but rather that he will not further delay an exposition, couched in simple and intelligible language, of the elementary and fundamental notions, definitions and principles on which his work rests. This might enable his friends to determine whether his theories 'are peculiarly wild and vagarious' or his results 'meaningless.' And he must not forget that their judgment has been in suspension for a long time. M.

VARIATIONS OF GLACIERS.

TO THE EDITOR OF SCIENCE: At the International Congress of Geologists at Zurich in 1894 a committee, with members representing various countries, was appointed to collect and make observations on the changes which are continually occurring in the length and thickness of glaciers. Much information bearing on the variations of the Alpine glaciers has already been collected, and it is now desirable to know something of the variations of glaciers in other parts of the world, to determine whether these variations are synchronous on different continents and on opposite sides of the equator. To what extent the variations of glaciers are dependent on meteorological changes, and to what extent on the size and shape of reservoirs, etc., is a problem whose solution is hoped for.

Many of your readers will doubtless visit American glaciers this summer, either on the Pacific Coast, in Canada or in Alaska; and I hope they will take sufficient interest in the subject to make observations which will be of value.

The information most desired regarding any glacier is whether it is advancing or retreating. In a memorandum issued by the Alpine Club the following criteria are given:

"When the ice is advancing the glaciers generally have a more convex outline, * * * and piles of fresh rubbish are found shot over the grass of the lower moraines. Moraines which have been comparatively recently deposited * * * are disturbed, show cracks, and are obviously being pushed forward or aside by the glacier.

"When the ice is in retreat the marks of its further recent extension are seen fringing the glacier both at the end and sides * * * ; the glacier fails to fill its former bed and bare stony tracts, often interspersed with pools or lakelets, lie between the end of the glacier and the mounds of recent terminal moraines."

For recording the extent of a glacier at the time of one's visit, many methods bave been given. Among the simplest is to measure (or pace) the distance from the end of the glacier to some prominent rock, or to the line connecting two easily recognizable points on opposite sides of the valley. All photographs of the end of a glacier are useful, especially those taken from a station easily accessible and easily described; photographs taken from the same station at a future date will show what changes have taken place in the interval.

Excellent results can be obtained from the following method: Select two stations on opposite sides of the valley a little below the glacier's end; mark and describe them; estimate their distance apart if no more accurate determination can be made; take a photograph of the glacier's end from each of these stations, and determine by compass the angle between the other station and two or three prominent peaks or other features that appear in each photograph. The photographs, the angles and the distance between the stations will be sufficient data to make a rough map of the glacier's end.* All photographs and observations sent to me will be carefully preserved as a part of a permanent record of American glaciers.

Muir glacier, Alaska, is so frequently visited that we should obtain a pretty complete history of its changes. A photograph of the northwestern corner of the inlet, taken from the ship when at anchor, or, better still, from the projecting bluff on the eastern side of the inlet, will greatly help in making the record.

The few observations which have already reached me show that the glaciers about Glacier Bay, Alaska, the Illecellewaet, in the Selkirks, and those on Mt. Rainier, Washington, are retreating. HARRY FIELDING REID.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD., May 23, 1896.

*A fuller account of the desired observations is given in the *Journal of Geology*, Chicago, Vol. III., 1895, pp. 284–288.

LIFE HABITS OF PHRYNOSOMA.

PROF. CHAS. L. EDWARDS'S article on the reproduction of *Phrynosoma cornutum* (SCIENCE, May 22, 1896) interested me very much, indeed; but in some respects the article is misleading, as one might suppose from reading it, that Prof. Edwards believes that all the species of lizards of the genus *Phrynosoma* are *oviparous*, as he found *P. cornutum* to be. This is, however, by no means the case, for, as I have pointed out in SCIENCE over ten years ago (September 4, 1885, pp. 185–186), *Phrynosoma douglassii* is strictly viviparous, and its period of gestation is probably about one hundred days. At the present writing I have alcoholic specimens of the young of this species that were given birth to in my presence by a specimen of *P. douglassii*, kept by me in captivity in New Mexico in 1885. R. W. Shufeldt.

May 27, 1896.

BOWS AND ARROWS OF CENTRAL BRAZIL.

Editor of Science: I have just finished reading Dr. Hermann Meyer's 'Bogen und Pfeil in Central Brasilien' (Leipzig, 53 pp., 4 pl. of 67 figs., map), and find it good for sore eyes. His purpose to prepare a much larger work is declared at the outset, and his confession that the shortcomings and sins of collectors and labelers are at the bottom of the ethnographer's disappointments and errors will find an echo in many hearts. Indeed, Dr. Meyer has actually gone to the Mato Grosso to ascertain whether these things that were on his labels are really so.

All bows in South America are self bows. There is not now, and does not seem ever to have been, a made-up bow south of the Caribbean Sea. For the most part, these southern bows are very large, only in Guiana and the northwestern lands, as well as in the far south, in the Gran Chaco, on the Pampas and in Tierra del Fuego, are smaller forms in use. Quite contrary to Ratzel's observations on Africa, the powerful bows are to be found in forest regions, while the smaller ones are in the open.

In the central region studied by Meyer there are five types of bow, to wit:

1. The Peruvian, with rectangular long elliptical cross-section. The material is the heavy, black Chonta palm wood.

2. The North Brazilian, with semi-circular cross-section and made of a reddish brown leguminous wood.

3. The small Guiana bow, with parabolic cross-section, and often with a channel down the back. They are made of a dark brown wood. There are intermediate forms between 2 and 3.

4. The small Chaco bow, with circular cross-section and beautifully smoothed. Made from the red wood of the Curepay acacia.

5. East Brazilian bows of a variety of woods. There are two varieties, the eastern and the western; the northern, or Shingu, and the southern, or Kameh, form connecting links between them. The western variety has circular cross-section, is made of strong wood and wrapped with 'Cipo' a Liana bast, used by the Bororo (Tupi). The eastern variety is of black Airi palm wood, in use among the Puri (Tapuya, or Gêz) and Botocudo (Tapuya, or Gêz).

Of arrows, Meyer characterizes six types, all having two feathers instead of three. In North America the Eskimo and several west coast tribes employed two feathers laid on flat, one above, one below. All the interior and eastern tribes seem to have had the rounded or cylindrical nock and three radiating arrows. The South American types are:

1. The East Brazilian or Gêz, Tupi feathering, occupying all east Brazil to the Paraguay and the Shingu. Two, whole, or seldom halved, feathers are laid on to the shaft flat, one above, one below, and seized with thread, filament or Cipo bast. These wrappings are frequently done in beautiful patterns and pretty tufts of feathers are inserted.

2. Guiana feathering, delicate and carefully laid on. Two short, half feathers are laid on and held fast by wrappings of threads here and there. Once in a while a North American arrow has the feathers thus made fast.

A bit of wood is inserted at the butt end for a nock piece.

3. The Shingu sewed feathering. Two half feathers are sewed on to the shaftment through little holes bored through on either side.

4. Arara feathering, two long half feathers held on by narrow bands of thread wrapping. At the butt end the wrapping is in beautiful patterns.

5. Mauhé feathering, like the East Brazilian, two whole feathers are bound on above and below. A neck piece is inserted at the butt end.

6. The Peruvian cemented feathering. The half feathers are first laid on and held in place by a coil of thread or bast from end to end and then covered with some sort of dark cement. This is subdivided into minor groups.

The shaft, the fore shaft, the barbs, the points of bamboo blades, of monkey bones or of wood, all receive minute attention. The most of the treatise is devoted to the tracing of tribes (Stämme) by means of their bows and arrows.

Meyer's map will be a revelation to any student of South American ethnology. Brinton has traced the Arawak from the Paraguay river to the Bahama Islands. Long ago I was struck with South American characteristics upon wood carvings from Turk's Island and among tribes of the Southern States. Holmes draws attention to peculiar pottery marks from the South in the Gulf States, and Meyer shows that the region of the Matto Grosso northward was a cloaca gentium, especially the common sources of the Paraguay, the Shingu and the Tapajos and the lower courses of the Tapajos, the Madeira and the Negro. The Negro is joined to the Orinoco by the Cassiquiare, and from the mouth of the Orinoco to Florida is an unbroken chain of inviting islands. Dr. Brinton denies that the Carib stock passed far north into the Antilles, but there seems to have been an easy and much-frequented highway from the Paraguay as well as from Yucatan to Florida for peoples. In this connection von den Steinen, Ehrenreich and Im Thurn must not be neglected.

O. T. MASON.

SCIENTIFIC LITERATURE.

FOSSIL PLANTS OF THE WEALDEN.

The Wealden Flora. By A. C. SEWARD, M. A., F. G. S. Part I.—*Thallophyta-Pteridophyta*, London, 1894. Part II.—*Gymnospermæ*, London, 1895. Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). Parts I., II.

The second part of this important work has come to hand. The first part appeared in June, 1894, but as Part II. was expected even earlier than it arrived no review has appeared in America of Part I., and the whole work may now be treated together. An additional part is promised, which will embody certain critical discussions, but as no plants have been found in the English Wealden of higher rank than the Gymnosperms these two parts must contain an enumeration of the entire flora so far as known.

At the time of receiving the first part I was about starting for Europe, and while there I made some investigations in the Wealden with a view to comparing that formation with the Potomac of the United States. I was therefore able to make excellent use of the information it contained when preparing a paper on 'Some Analogies in the Lower Cretaceous of Europe and America' for the Sixteenth Annual Report of the U. S. Geological Survey (pp. 463–542), chiefly growing out of the observations I had made. That paper is now in press, but it might have been made much more complete if I had received Part II. of this work in time to make use of it. As I have expressed in that paper my appreciation of the important information contained in Part I., and have embodied a considerable part of it in the comparisons there instituted between the Wealden flora and that of the Potomac formation, it is not necessary to go into detail relative to this portion of Mr. Seward's work. Its title sufficiently indicates its scope; thirty distinct forms are treated, the greater number of which are ferns. There are two algæ, one Chara, one hepatic and three species referred to Equisetites. Nine of the forms have more or less geographical distribution outside of England, and a table is given showing this.

It may be said of the whole work that, although constituting, as the title page indicates, the beginning of a catalogue of the Mesozoic plants in the British Museum, it is much more than a catalogue. All the material in the Museum has been carefully revised, and though treated somewhat by number it is dealt with in a systematic way, and there are many references to similar material in other museums. The literature of the subject is also fully given, and all new material is described and named. There is a large amount of this latter, the greater part of which has been collected by Mr. P. Rufford, of Hastings, for whom many species and one genus have been named. Many of the old specimens collected by Mantell and the early geologists have been thoroughly worked over and referred to modern genera, so that we now have some idea of the real nature of such objects as *Endogenites erosa*, which is shown to be a fern (*Tempskya Schimperi* Corda), while the old genera Pecopteris, Alethopteris, Lonchopteris, and most of Sphenopteris have been brought within the Mesozoic genera, Matonidium, Cladophlebis, Weichselia and Ruffordia. Anyone who has had to deal with these old names can realize the importance of Mr. Seward's work.

In Part II., so recently published and to which it is proposed chiefly to draw attention, Mr. Seward has taken up the Gymnosperms, which, as already remarked, are the only Spermaphytic or Phanerogamic plants which have, as yet, been found in the Wealden. These all belong to the two orders Cycadaceæ and Coniferæ, unless we suppose, as Mr. Seward seems to do, in common with most other authors who have studied that group, that the Bennettiteæ constitute an order distinct from and intermediate between the Cycadaceæ and the Coniferæ.

Mr. Seward has devoted considerably more than half his space to the Cycadaceæ in the wider sense, and, although the number of forms is not large, still the great difficulty that attends the study of this class of material, as well as the importance that such a study has, both for biology and geology, fully justifies the thoroughness of his treatment. In view of the recent importance which the subject of cycadean vegetation has assumed in America, this able and excellent review of it by so competent an authority as Mr. Seward is in a high degree timely and valuable.

Although he gives the opinion of the leading investigators, Carruthers, Solms-Laubach, etc., to the effect that the Bennettiteæ cannot be placed in the Cycadaceæ, still he does not himself make this distinction in the work before us, and treats all the forms that have been commonly referred to the Cycadaceæ under that ordinal name. His subdivision is mainly into *Frondes*, *Trunci* and *Flores*, and in addition to these he deals with several doubtful organs and with numerous seeds (Carpolithes).

One of the most valuable parts of the work is an extended discussion of the fossil Cycadaceæ, occupying twenty pages. He first goes over the evidence for the existence of this family in Paleozoic beds, and the conclusion is decidedly in favor of such a view, with, however, the qualification that the Paleozoic Cycadaceæ are more or less synthetic in their nature and possess marked relationships with less highly developed groups and especially with ferns. I know of no other place in which the proof of the Pteridophytic ancestry of the Cycadaceæ in particular and of the Gymnosperms in general has been so ably marshaled. It constitutes another step in the general march of botanical science towards the breaking down of the barriers which formerly so completely separated the Cryptogams from the Phanerogams. Only those narrow systematists who are chiefly in search of differences, and who so dread to encounter resemblances, can regard this in any other light than that of true scientific progress.

Of the forms which are known only by their fronds Mr. Seward recognizes six genera and fourteen species in the English Wealden. The genera are: Cycadites, Dioonites, Nilssonia, Otozamites, Zamites and Anomozamites. Of these Otozamites is represented by six species and varieties, Cycadites, Dioonites and Zamites by two each, while of Nilssonia and Anomozamites only one species of each has been found thus far. Four of these forms are described as new, two of which, *Cycadites Saportæ* and *Zamites Carruthersi*, have the rank of species, the other two new forms being varieties of the old species *Otozamites Klipsteinii* Dunk., of the German Wealden. The remainder of the fronds are identified with species long since recognized either by the earlier English or by Continental authorities.

Each of these genera and many of the species are carefully discussed and a somewhat extended synonymy is appended. Numerous changes are also made, of which only one need be mentioned, viz., the adoption of Schenk's view of the form which has so long gone by the name of *Dioonites Buchianus* (Ett.) Born., and its reference to the genus Zamites. This has special interest for the American paleobotanist, because it is one of the most abundant forms in the oldest beds of the Potomac formation. This form was first supposed (Göppert, 1847) to belong to Pterophyllum, and its provisional reference to Dioonites by Bornemann in 1856 would have received little attention had it not been adopted by Schimper in his Traité de Paléontologie Végétale, and its reference to Miquel's genus Dioonites has always been doubted by some authors. The last change was that of Nathorst, who, recognizing its affinities with

Zamia rather than with Dioon, proposed in 1890 to call it Zamiophyllum. This is in harmony with Nathorst's fundamental principle of nomenclature to make all doubtful genera founded on leaves terminate in *-phyllum*. Objectionable as this rule is in the case of dicotyledonous leaves (see Amer. Journ. Sci., 3d Ser., Vol. XXXI., May, 1886, pp. 370-375), it is still more so for plants of lower rank, as monocotyledons, while in families in which the appendicular organs are not true leaves, but fronds, as in the case of cycads and ferns, this practice is highly objectionable, and it is matter for congratulation that Mr. Seward, in recognizing the same truth perceived by Nathorst, has restored Schenk's name. Apropos of this form it is to be noted that Mr. Seward declines to recognize Prof. Fontaine's two varieties from the Potomac formation and Nathorst's variety from Japan, and that he also includes in this species the other Japanese form to which Nathorst gave the name *Zamiophyllum Naumanni.*

Passing over many other interesting features of this portion of the work and also his treatment of flowers and fruits, we come to the section which, just at present, has the greatest interest for the student of American paleobotany, viz., that which treats of the cycadean trunks. It is no secret that a monograph on the Cycadean Trunks of North America is in preparation at the U. S. National Museum, and that a large amount of material, especially from the Potomac of Maryland and the Lower Cretaceous of the Black Hills, has been brought together as a basis for this study. Several preliminary notes and papers have already appeared,* bearing on this subject, but unavoidable delays have prevented the progress of the work, and it will be some time before its completion. This much is said because Mr. Seward has several times referred to the probable early appearance of this monograph (see Pt. II., pp. 120–121 of the work under review). One of the causes of delay was the necessity which was felt of visiting the European museums and examining the great collections of cycadean trunks in England, France and Italy. The paper above referred to* gives a somewhat full account of the investigation of this nature which was made in 1894.

*See SCIENCE, Vol. XXI., June 30, 1893, p. 355; Proc. Biol. Soc. Washington, Vol. IX., April 9, 1894, pp. 75–88; Journ. Geol., Vol. II., April–May, 1894, pp. 250–266; Bull. Torr. Bot. Club, Vol. XXI., July 20, 1894, pp. 291-299.

In restricting the Wealden to the beds that lie between the Purbeck and the Atherfield beds (he seems to include the Lower Greensand) Mr. Seward has excluded from the consideration of cycadean trunks the oldest and best known forms, viz., those from the 'dirt beds' (Purbeck) of the Portland quarries, first described by Buckland in 1828 under the name of Cycadeoidea. The number of distinct forms confined to the true Wealden is not large and Mr. Seward has treated them under the generic names Bucklandia, Fittonia, Bennettites and Yatesia. Bucklandia includes certain cylindrical trunks of considerable height in proportion to the diameter, the most important being *B. anomala* (Stokes & Webb) Carr., first described in 1824 as *Clathraria anomala* Stokes & Webb, though previously collected and subsequently treated by Mantell under the name *Clathraria Lyellii.* A large number of specimens of this are in the British Museum, all of which have been examined by Mr. Seward and separately described. There are also some forms exhibiting only the medulla or pith, which Mr. Seward thinks may belong to Bucklandia, but which come under Saporta's designation Cycadeomyelon. Two species of Yatesia, one of which is the *Y. Morrisii* of Carruthers, are also enumerated, but Mr. Seward seems to have grave doubts as to whether this genus can properly be separated from Bucklandia. A new species of Fittonia from Mr. Rufford's collection is described, but scarcely any mention is made of the original species *F. squamata* Carr., because it is in the Geological Museum on Jermyn street. It is a pity that this work should not have sufficiently expanded to include all the material from the Wealden, seeing that so nearly all is actually in the British Museum.

We come now to that form which is certainly of the greatest interest from whatever point of view, viz., the genus Bennettites of Carruthers,

*Sixteenth Annual Report U. S. Geol. Surv., 1894–'95, pp. 463–542, pl. xcvii–cvii.

upon which has been founded a distinct order Bennettiteæ. This is not the place to go into a full discussion of the important characters which distinguish this form. They have been fully considered by Carruthers, Solms-Laubach, Saporta and Lignier. Mr. Seward sums them up with characteristic conciseness and refers to this genus six or seven distinct forms including the *B. Saxbyanus* and *B. Gibsonianus* of Carruthers. Solms-Laubach, it will be remembered, confined the genus to the latter of these species solely on the ground that the remarkable trunk found on the Isle of Wight and so fully illustrated by Carruthers is the only one in which the included seeds are clearly shown. The remaining species he preferred to place in Buckland's old genus Cycadeoidea. Since the publication of Lignier's interesting researches upon the structure of *B. Morierei*, the opinion has gained recognition that there is a close relationship between the genus Williamsonia and Bennettites. Mr. Seward fully discusses this in an extended introduction to a new species collected by Mr. Rufford in the Fairlight clays near Hastings, which he names *Bennettites* (*Williamsonia*) *Carruthersi*. This species is represented by no less than seventeen specimens, and in addition to this there is a variety (*latifolius*) of which some dozen specimens occur. These all come under the head of *Flores* or floral organs, which are carefully illustrated in two plates and one text figure. Some of these forms certainly resemble those referred to Williamsonia from the Potomac formation; others, it must be admitted, can scarcely be separated from the specimens so fully illustrated by Lignier, while still others seem to be substantially identical with those figured so long ago by Young and Bird from the Yorkshire Oölite and subsequently treated by Williamson under the name of *Zamia gigas*. Carruthers recognized the undesirability of referring such forms to the genus Zamia, and therefore founded the genus Williamsonia.*

So far as known at the present writing, none of the cycadean trunks of America reveal the presence of the included fruits characteristic of *Bennettites Gibsonianus*, but in all other important respects these trunks resemble those which Mr. Seward refers to this genus, and also all those which Count Solms-Laubach would include under the name Cycadeoidea. So far as their general appearance is concerned, both the American and the Italian forms depart from the original type of Buckland more widely than from the Bennettitean trunks of the Wealden. The fact that Count Solms appears to have found included anthers in the great Italian trunk *Cycadeoidea etrusca* seems to indicate that throughout this great group of closely similar forms the reproductive organs were the same, and that the failure to find fully developed seeds in the interior of most of these trunks is due to defective preservation. It is not probable that these seeds could long remain thus imbedded in the cortex; they must have possessed some mode of extrusion, and it must have been a rare accident that a trunk should be entombed at the precise time when its mature seeds were still included. This seems to have been the case with *B. Gibsonianus*—a most happy accident for science. But in most other specimens, and especially in many of the American, there are indications within the floral axis of the remains of former organs that have disappeared. In some specimens these flowers closely resemble the one studied by Lignier, and the enveloping bracts are either still preserved or else are indicated by definite cavities having the same form. It therefore seems at least a reasonable conclusion that most or all of the trunks referred to Cycadeoidea by Solms-Laubach are of practically the same nature as *Bennettites Gibsonianus*. Further investigations now in progress are likely to throw additional light upon this subject.

One other supposed cycadean trunk described by Mr. Seward is of special interest because it is that upon which was formally founded the *Dracæna Benstedi* Koenig, which occurs so often in the books. We have here at last the history of this problematical form, first mentioned by Mantell as having been discovered by Bensted at Maidstone and supposed by him to be related to Yucca or Dracæna. Koenig, who was keeper of the Mineralogical Department of the British Museum where the specimens were, seems to have labelled them by this name, and

*See SCIENCE, N. S., Vol. II, No. 32, August 9, 1895, p. 147.

Morris in his Catalogue of British Fossils, perpetuated it. Mr. Seward has examined the specimens and finds them to be in all probability cycadaceous, but he unfortunately declines to apply to them either a generic or specific name. This disposes of the last claim of the British Wealden to any monocotyledonous vegetation, the old *Endogenites erosa* having been long since referred to the ferns.

The coniferous vegetation of the Wealden is only second in importance to its cycadean vegetation. It is not as well preserved and there is no doubt much truth in Mr. Seward's remark that "as a general rule, fossil conifers are perhaps the most unsatisfactory plants with which the palæobotanist has to deal; structureless and imperfectly preserved fragments of broken twigs, isolated cones, leaves or seeds, have usually to be determined separately, and it is only in comparatively rare instances that we are in a position to connect cones and vegetative branches."

Sixteen distinct forms are enumerated in this catalogue. They are all referred to the genera Araucarites, Pinites, Sphenolepidium, Thuites, Nageiopsis, Pagiophyllum and Brachyphyllum. The largest number of species belongs to Pinites, viz., five, while of Sphenolepidium there are three, and of Araucarites, Pagiophyllum and Brachyphyllum, two each. It is interesting to note that three of the specimens in the Rufford collection are referred to Prof. Fontaine's Potomac genus, Nageiopsis, and Mr. Seward regards them as probably the same as *N. heterophylla* Font. Pinites is represented chiefly by cones, which somewhat resemble those of Abies, and this is perhaps the most unsatisfactory group of the conifers. The two widely distributed species of Sphenolepidium, *S. Kurrianum* and *S. Sternbergianum*, both originally from the Wealden of Germany, and both of which occur in the Potomac formation, are also found in the Wealden of England. Mr. Seward is disposed to include Prof. Fontaine's *S. virginicum* and also his *Athrotaxopsis expansa* under *Sphenolepidium Kurrianum*. Another species is either the same as or closely related to the *Sequoia subulata* of Heer, also found in the Potomac formation. It would perhaps not be wholly untrue to regard the genus Sphenolepidium as a sort of connecting link between the Araucarian and the Sequoian types of coniferous vegetation.

A very brief space is devoted to the coniferous wood of the Wealden, and it would seem from the specimens enumerated that there is in the British Museum no material whatever from the celebrated 'pine raft' of Brook Point, on the Isle of Wight. This seems surprising, in view of the great prominence and wide fame of these petrified remains. Only a macroscopic examination seems to have been made of the few specimens from Hastings and Ecclesbourne. This is very disappointing to those who would be glad to avail themselves of the knowledge that could be so easily acquired from this important class of material. If we knew the structure of all the fossil wood of the Wealden of England we should doubtless have a good basis upon which to judge of much of the other material that is so largely in doubt.

The great botanist, Robert Brown, in the early years of the century, examined the internal structure of this fossil wood of the Isle of Wight and reported that it agreed with that of the Norfolk Island pine (*Araucaria excelsa*). No figures were ever published that I can learn. On my brief visit to the island I collected a few specimens, and these have been prepared and slides mounted by Dr. Knowlton. His report upon them is contained in the paper above referred to.*

The Araucarian type of structure is not found in any of the fossil wood of the Potomac formation, but has been found in that of the Lower Cretaceous of the Black Hills. It is the common type of the Older Mesozoic (Upper Triassic) deposits of the Eastern United States. The Potomac wood is all of the Sequoian type, although it has been called Curpressinoxylon. Hitherto no plants of that class have been found in the Wealden, but the occurrence of *Sequoia subulata*, or a species closely allied to it, together with the forms of Sphenolepidium, seem to mark a transition from the Araucarian to the Sequoian conifers. It may be that the numerous imperfectly preserved cones that have been referred to Pinites belong to the same plants whose wood is preserved in the

*Sixteenth Ann. Rept. U. S. Geol. Surv., p. 496, pl. cii., figs. 5, 6 (in press).

Wealden, and this is almost certainly the case with the specimen referred to Araucarites (*Conites elegans* Carr. and *Kaidacarpum minus* Carr.). The difference, therefore, in this respect between the Potomac formation and the Wealden may not be as great as was supposed.

My principal object in visiting the Wealden was to see what could be learned of its relationship with the Lower Cretaceous of the United States, and in the paper already twice referred to I have pointed out all such relationships, both stratigraphical and paleontological, that I was able to detect on that brief visit. The general result seems to be that there are marked similarities in both these respects, and that the Wealden formation is like the Potomac, not only in its flora, but also in the manner in which it was laid down. The two seem to form a special epoch in the history of geology, and it may well be that the events which their strata record were in large part taking place at the same time on both sides of the Atlantic.

In reviewing such an important and able work as the one before us, it is greatly to be regretted that there should be anything in it to which a hearty assent can not be given, and it is fortunate that the only part of the book from which anyone could dissent is that which relates to so unimportant a matter as nomenclature, which is regarded by many as of no consequence at all in comparison with the scientific problems that are demanding solution. And yet we can no more dispense with a nomenclature than we can dispense with language. It is in a certain sense the language of science, and as such it should possess all the precision that science requires in all departments. Those who regard it as of no value should not forget that the great Darwin, whom no one can accuse of being a systematist in any sense of the word, considered the subject of nomenclature of such paramount importance that he actually bequeathed a sum of money to be devoted thereto; and all scientific workers, I think, no matter what branch of science they pursue, feel the same need that the language of science and the nomenclature of its innumerable facts, especially in the organic world, be reduced to the most perfect form for their use.

In what I shall say relative to the nomenclature employed in this book, I do not wish to be understood as specially criticising its author, but rather as characterizing, in the most general way, what I regard as a defective system. This peculiar nomenclature is, so far as I am aware, confined to the botanists and paleobotanists of Great Britain and of one or two botanical centers in the United States. In all other branches of science and among botanists of all other parts of the world, no such system is employed, and it is not tolerated except by this restricted class. It is based on the assumption that the author of a name has no more title to that name than anyone else, and that any subsequent author is at liberty to change any name that he regards as 'objectionable.' Of course there is no agreement whatever as to what makes a name objectionable, and therefore in practise it amounts to the right of any author to change any name at will. It is this principle, or, rather want of principle, that has thrown the nomenclature of botany into such inextricable confusion and renders it next to impossible for any writer who has not all the botanical literature of the world before him to decide what is the true name of any genus or species. I will cite only three cases in the present work as fairly illustrative of this point.

On page 173, Mr. Seward creates a new genus *Withamia*, as a 'substitute' for Saporta's genus *Cycadorachis*, given by the latter to forms found in the lower Kimmeridgian, which he believed to represent the rachis of a cycad frond. In making this change Mr. Seward remarks: "Although it is held by some a wrong course to adopt, I propose to substitute, in the case of *Cycadorachis armata* Sap., and the almost identical fossils from the English Wealden, a new generic name in place of that instituted by Saporta. To retain Saporta's genus, with the recently discovered specimens before us, would be practically equivalent to assigning the plant to a position which appears to be entirely at variance with the facts. I propose, therefore, to institute the new genus *Withamia* for these spiny axes with leaf-like appendages, and in doing so to place on record some slight recognition of the immensely important service which Witham of Lartingdon rendered to paleobotanical science."

I cite this case as an exceedingly moderate one. Probably no better reason could be assigned for changing a name. But what will be the result? Some later author, with better specimens at hand, will think he discovers the relation of these forms with some genus or family, and will therefore again change the name so as to indicate this determination; or he may have no better reason than the laudable wish to do honor to some other eminent predecessor whom he regards as having been neglected, and then we shall have three names for the same thing, and so on indefinitely.

I will cite in the next place, the case of *Yatesia Morrisii* Carr., described on page 166. Here a short synonymy is given with the date of each change placed conspicuously at the left, and the first entry in this synonymy is:

1867. Cycadeoidea Morrisii, Carruthers, Geol. Mag., Vol. IV., p. 199.

If the reader turns to the reference given in the *Geological Magazine* he will find a paper by Mr. Carruthers entitled '*On cycadeoidea Yatesii*, a fossil cycadean stem from the Potton Sands, Bedfordshire.' If I had not happened to have worked up this synonymy I should of course have accepted Mr. Seward's statement, but having done so and arrived at the conclusion that the true name must now be *Yatesia Yatesii* Carr., I was, of course, struck by the discrepancy. It is true that Mr. Carruthers in his subsequent larger paper in the Linnæan Transactions, three years later, at the time that he founded the genus Yatesia, had called this from *Yatesia Morrisii*, evidently because he considered that to give Yates's name to both genus and species was 'objectionable.' But why, in giving the synonymy, should not the actual facts be stated, so that the responsibility should rest where it belongs? The entry *Cycadeoidea Morrisii*, Geol. Mag., 1867, is simply a falsification of the record. Although Mr. Seward's synonymy appears upon the face to be carefully prepared, yet such facts as these show that it is not to be trusted, and the reader is compelled in every case to go back to the original and find out whether the entry is correct or not. Clearly such synonymy is far worse than none.

The third and only other case that I shall cite is that of *Bennettites Gibsonianus* Carr., on page 142. Here ten references are given in the synonymy under the name, representing three changes. Mantell's *Clatharia Lyellii* has, of course, been set aside for proper reasons, and the earliest entry by Carruthers is that of *Bennettites Gibsonianus* in Trans. Linn. Soc., Vol. XXVI., p. 700, 1870. The last entry in Mr. Seward's synonymy is as follows:

1894. Cycadeoidea Gibsoni, Ward, Biol. Soc. Washington, Vol. IX., p. 80.

From this the reader will, of course, suppose that the last named author deliberately changed the specific name from *Gibsonianus* to *Gibsoni*, and will hold him responsible therefor. Very few will have before them the little paper quoted, but those who chance to have it will find on the page cited that the first entry under the synonymy is as follows:

1867. Bennettites Gibsoni Carr., Brit. Assoc. Rep., 37th meeting, Pt. II., p. 80.

This entry is correct, but is conveniently omitted in Mr. Seward's synonymy. This spelling of the specific name, therefore, has three years priority over the other, and if there were any other test of the propriety of a name than that it is the first one given, the earlier one in this case is the better, because the specimen was collected by Gibson, and the general practice is to employ the genitive form for names of persons who have some immediate connection with the specimen, usually as collector, and the adjective form for those whose connection is remote, and especially where the purpose is merely to honor one who may not be related to the existing case at all. But two reasons are no better than one. The reference to Mr. Carruther's earliest name should, of course, have been given under its proper date, and the last entry should have been:

1894. Cycadeoidea Gibsoni (Carr.) Ward. This would have completed the record and satisfied the ethics of the case.

Of course, it may be objected that the name *Bennettites Gibsoni* Carr. was a *nomen nudum*, as no description or figure accompanied it in the note referred to, but the school of botanists to which reference has been made have never troubled themselves with any such refinements in nomenclature as this. Mr. Carruthers preferred Brongniart's *nomen nudum Mantellia nidiformis* to Buckland's *Cycadeoidea megalophylla*, although the latter was thoroughly described and illustrated and also had priority, as he, himself, admits. In the example before us the last author named is, of course, responsible for referring Bennettites to Cycadeoidea, which, whether correct or not, was a legitimate change and the reasons were given in the paper referred to.

These three cases will suffice to furnish the standard by which the whole is to be judged, and it is obvious that the system of citation adopted in this work, which is simply representative of the whole class of writers referred to, and for which its author should not be held personally responsible, involves both the *suppressio veri* and the *suggestio falsi.* That this should be tolerated in any department of science, the essence of which is truth, is surely beyond the ordinary comprehension.

LESTER F. WARD.

WASHINGTON, D. C.

A Summary Description of the Geology of Pennsylvania. J. P. LESLEY, Harrisburg. Vols. I. and II., 1892; Vol. III. in 2 parts, 1895. pp. 2638 and 611 pl., with an index volume of pp. 98 and xxx.

These volumes, completing the series of Pennsylvania reports, are offered as a digest of about one hundred volumes, averaging not far from two hundred pages each. A review, even a synopsis, is impossible; space admits merely of a notice.

Prof. Lesley's contribution covers the column from the base to the Mauch Chunk of the Lower Carboniferous; failing health compelled cessation of work at that point, and the compilation had to be completed by others. The portion described by Prof. Lesley is found in the most complicated part of the State, and the problems with which he had to deal were numerous and perplexing. The conclusions offered by geologists in adjoining districts were often discordant, and the termination of the survey came too soon to admit of careful re-study of doubtful areas. As a result, the first two volumes of this report contain many defective spots, which the author does not attempt to conceal. The Cambrian and Ordovician, studied chiefly during the early years of the survey, need thorough revision, and the relations of the Pennsylvania Silurian to that of other States are still somewhat obscure. The discussion of the Devonian is careful and as acceptable as any discussion of the Pennsylvania Devonian can be at this time. The numerous deep oil borings in southwest Pennsylvania and West Virginia will afford new material for study of the problems involved. Prof. Lesley's industry is simply appalling; he has mastered the details of the reports in such way as to make them his own, and his portion of these volumes bears his own stamp on every page, so that we have not a mere compilation but a real presentation of the geology as far as the condition of our knowledge warrants. His anxiety to escape the 'error' of the director of the First Geological Survey of the State is shown in the effort to fasten every geologist's name to his work, even, at times, to the extent of crediting to the geologist in charge of a district observations which were only confirmatory of his own made many years before. His readiness to give a hearing to both sides is evidenced not merely by the insertion of an argument, by another, of thirty pages controverting a position strenuously defended by him for more than twelve years, but also by his relegation to the doubtful column of opinions long regarded by him as proved.

The Mauch Chunk west from the Anthracite fields and the Pottsville conglomerate throughout the State are described by Mr. d'Invilliers in Vol. 3, pp. 1833–1915. The synopsis of the labors of Prof. White and others is given clearly and compactly and with a reasonable effort to assign to each author proper credit for his work.

The Anthracite fields are described by Mr. A. D. W. Smith on pp. 1916–2152; this summary appears to be in large part supplementary to the reports and work of Messrs. Ashburner and Hill.

The Bituminous coal fields are described by Mr. E. V. d'Invilliers, on pp. 2153–2588, this description forming the greater part of Vol. III., Pt. I. Mr. d'Invillier's work has been conscientious and successful, so that his synopsis cannot fail to be useful to geologists as well as satisfactory to the citizens of Pennsylvania, the features of the beds being given in great detail. This synopsis cannot fail to be gratifying, in one sense, to Mr. d'Invillier's predecessors in the bituminous fields, for he has made excellent use of their work. But an oversight, doubtless unintentional on Mr. d'Invillier's part, cannot fail to detract from the pleasure with which his predecessors should read his synopsis; he has failed to give credit to them in the proper places to such an extent that those who use his work hereafter will be apt to regard him as author rather than as compiler.

The report closes with a review of the New Red, by Mr. Benjamin Smith Lyman, which is a synopsis of his own work and a valuable contribution to the literature of the subject.

The index is quite a marvel in its way. If the purpose of its maker had been to conceal the names of the geologists on whose observations the report is based it could hardly have been more successful along that line. Of the geologists in charge of districts, Dewees, W. G. Platt, Carll and Prime are not mentioned; McCreath, whose chemical work made the survey celebrated, is ignored in the same way. No notice is taken of the work of F. and W. G. Platt, Stevenson and White in the bituminous fields; even Lesley himself is alluded to but once, while the work of one of the compilers requires twenty-six references, that of another five, and that of a third none. The list of publications following the index is even more successful than the index itself, for all of the volumes appear to be anonymous except the two publications by Dr. Genth.

JOHN J. STEVENSON.

Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus, herausgegeben von PROF. DR. G. HELLMANN:

No. 5. *Die Bauern-Praktik.* 1508. 4°. Pp. 83.

No. 6. *Concerning the Cause of the General Trade Winds.* By GEORGE HADLEY. London, 1735. 4°. Pp. 21.

Facsimiledrucke, mit Einleitungen. Berlin, A. Asher & Co. 1896.

One of the signs that meteorology is now rapidly advancing as a science is the fact that more and more attention is being directed to the ancient writings which marked the first steps in its development. As new discoveries are being made, and as the modern literature of the subject is increasing, we appreciate more fully what the early students and writers did for us, and we are glad to become familiar with their work. The return to the older authors has brought out, during the past two or three years, some interesting translations and reprints of ancient writings on meteorology. The most notable set of such publications is the series of *Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus*, edited by Dr. Hellmann, of Berlin, a very devoted student of meteorology. These reprints are attractively gotten up in rough, white paper covers, and are facsimile reproductions of the originals. Each number contains bibliographical and historical notes prepared by Dr. Hellmann, which is equivalent to saying that they are full, accurate and interesting.

The series of *Neudrucke*, which already included four reprints of old and rare publications, has lately been enlarged by the addition of two more volumes, Nos. 5 and 6. The first, No. 5, is a reprint of *Die Bauern-Praktik*, originally published in 1508 and undoubtedly the most widely known of all meteorological books. The original went through sixty editions in Germany, and was translated into French, English, Danish, Norwegian, Swedish, etc. The weather prognostics and rules of *Die Bauern-Praktik* may be found in the manuscripts of the 10th to 15th centuries, and, in their beginnings, may be traced back much further, even to the days of the Indo-Germanic tribes and to the ancient Chinese. The principal part of the original publication deals with the forecasting of the weather for the whole year on the basis of the weather observed on Christmas and on the twelve days following it. Although, of course, of no practical use to us at the present day, this reprint is of much interest historically to antiquarians and those interested in folk-lore, as well as to meteorologists.

No. 6, of the series, is a facsimile reprint of

Hadley's *Concerning the Cause of the General Trade Winds*, originally published in the Philosophical Transactions in 1735. This paper, although very short, was one of very great importance in relation to the theory of the trade winds. Hadley's explanation of the direction of these winds, which he rightly ascribed to the deflective effect of the earth's rotation, was not complete or accurate, yet his theory is commonly found given in many books of the present day. The paper was distinctly epoch-making, and, as such, is well deserving of a place in Dr. Hellmann's admirable series. The notes in the Hadley reprint are as full and as suggestive as in the other numbers.

The publishers of the *Neudrucke* are Asher & Co., of Berlin, but we are informed that Dr. Hellmann has sent over several copies of each of the last two volumes to Mr. A. Lawrence Rotch, Readville, Mass., in order that Americans may be saved the trouble of writing to Europe for them. The reprints may be obtained at cost price on application to Mr. Rotch, the price of *Die Bauern-Praktik* being $1.75, and that of the Hadley reprint 50 cents.

R. DE C. WARD.

SCIENTIFIC JOURNALS.

PSYCHE, JUNE.

THE body of the number contains but a single short article, in which J. W. Folsom describes and figures a new Thysanuran which he regards as representing a new genus and family, Neelidæ. Two supplements are added, in one of which T. D. A. Cockerell continues his descriptions of new species of bees of the genus Prosapis, mostly from Colorado and Nevada; in the other F. C. Bowditch gives a list of 674 Coleoptera found on Mt. Washington, N. H., both above and below the timber line, with brief notes.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 262D MEETING, SATURDAY, MAY 16.

THE evening was devoted to the discussion of *The Fauna and Flora of the Islands off the Coast of Southern and Lower California, Including the Gulf of California.*

Dr. E. L. Greene discussed in brief the flora of the islands. The entire group, from Guadalupe, off the coast of Mexico, lying a hundred miles or more distant from the mainland, to those forming the channel of Santa Barbara and holding distances of only thirty and forty miles from the Californian shore, is a remarkable group among continental islands, as presenting in its flora so many points of divergence from that of the adjacent mainland. The islands of the Atlantic seaboard, even those lying farther out at sea than do any of those of the Cailfornian coast, yield only such genera and species as are common on the continent. But in the case of the Mexico-Californian group there are not less than fifty good species already known which are absolutely peculiar to the islands; some of them representing even generic types, like *Lyonothamnus*, consisting of two very distinct species—one a large shrub, the other a small tree—with no very near relatives in any other part of the world. *Crossosoma*, another genus of shrubs, has one fine species indigenous to several islands, with none on the immediately neighboring mainland, though a second small and insignificant member of the genus occurs away beyond the continental mountain ranges, on the verge of the deserts of the distant interior. And this insular genus *Crossosoma* is almost more than a genus. It probably represents a natural order, some authors referring it to the Dilleniacæ, the genera of which are all Australian and South American, others placing it provisionally in the Papaveraceæ, while in character it is different from either family. The most surprising case of entire divergence from continental flora is that of four very strongly marked species of *Lavatera*, which are scattered up and down the archipelago, while not a single species is indigenous to the American continent, either North or South, all the generic allies of these fine shrubs being of the flora of the Mediterranean region, with the exception of three or four, which are confined to remote and truly oceanic islands.

Another and negative point of divergence between the insular and mainland floras is the almost or quite total absence from the island of representatives of certain of the most prevalent mainland genera, such as *Ribes Lu-*

pinus Astragalus Potentilla Horkelia and many more. Equally remarkable and interestingly suggestive is the fact that certain trees, shrubs and herbaceous plants, long known as extremely rare, or quite local, on the mainland shores—such as *Pinus Torreyana*, *Malacothrix incana* and *Leptosyne gigantea*—have more recently been found to occur in the most luxuriant abundance on these outlying islands. Their rare occurrence on the continental shore is at just those points where their seeds would naturally land if drifted across from the islands. The conclusion is unavoidable that, in so far as these belong to the continental flora, they have been given to it from the islands, these latter being their original habitat. In a word, the character of this insular flora departs from almost all known rules, and in so far that, viewed as to their flora, the whole group seem like oceanic islands crowed over against the border of a continent.

The land mammals of the islands were discussed by Dr. Edgar A. Mearns, who enumerated, in addition to the genus *Homo*, twelve genera and upwards of twenty species of native terrestrial mammals which are at present known to inhabit the islands off the coasts of southern and Lower California, and alluded to others remaining to be described by the energetic and adventurous naturalist, Mr. Walter Bryant, whose explorations of Guadalupe, Cedros, Esperito-Santo and the other islands off the Pacific and Gulf coasts of Lower California are so well known to naturalists.

Dr. Mearns described and exhibited specimens of a new mouse (*Peromyscus*) and a new kangaroo rat (*Dipodomys*) recently collected on Tiburon Island, in the Gulf of California, by Mr. J. W. Mitchell, who accompanied Prof. McGee on his latest expedition. He also remarked upon the close relationship existing between the island mammals as a whole and those of the neighboring mainland, insomuch that their origin from the latter could be readily traced in each instance, though none are actually identical, thus furnishing a plain and striking illustration of the evolution of species.

Of domestic animals, the goat, sheep, cow, donkey, dog, cat and house rat have been introduced on one or more of the islands, and, in several instances, some of them bid fair to destroy the native fauna or flora of certain islands.

In the discussion which followed this paper, Dr. C. Hart Merriam added a genus to the known mammal fauna of these islands, a species of the little spotted skunk (*Spilogale*) having been taken on Santa Catalina Island, one of the Santa Barbara group.

A skin of the Western Desert mule deer, (called '*Burro*'), was sent to the Society for examination by Prof. W J McGee, who obtained the specimen in the Sierra Seri Sonora. Dr. Mearns had also found this deer on the Western desert tract, both east and west of the Colorado river.

Mr. Harry C. Oberholser spoke briefly of the birds of the island, calling attention to the number of subspecies which were evidently descended from continental forms.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 50th meeting of this Society held May 27th, the last meeting until next fall, the following papers were read and discussed:

Texture and Structure of Soils: By PROF. MILTON WHITNEY, of U. S. Department of Agriculture. The following forces are usually spoken of as the principal ones in the disintegration of rocks and the formation of soils. 1. Changes of temperature. 2. Moving water or ice. 3. Influence of vegetable or animal life (shades the land; admits air; solvent action of the roots; chemical action of decaying organic matter, earthworms and bacteria). 4. Chemical action of air and water. 5. Oxidation and hydration. Attention was called to the fact that all of these forces, except the solvent action of water and hydration, are largely superficial and would not act at any considerable depth. They certainly can not explain the disintegration of rocks to a depth of 50 or 75 feet as is seen in the crystalline areas at the south. If the solvent action of water has been the main cause of the disintegration of rocks, then 50 per cent. of the rock must have been dissolved and carried away. If the rock has been split up by mechanical means into the minute grains of sand and clay then the resulting material must have swelled to twice its original volume. Lantern slides were exhibited showing the shape of soil grains and the relative size and surface area, and to illustrate some of the physical properties of sand and clay. Slides were also shown illustrating the texture of soils, and the economical importance of this subject in the distribution of crops was pointed out, the texture of soils adapted to many of the principal crops being shown.

By the structure of soils is meant the arrangement of the soil grains. This has an important geological bearing and a very important economic side. Slides were used to show grains of soil unflocculated as they exist in a puddled clay and flocculated as they exist in a loam soil. The effect of this on the relation of soils to rainfall was explained and the economic importance of the difference in the conditions maintained by the soils owing to the difference in the structure was pointed out.

Topographic Nomenclature of Spanish America. Mr. Rob't T. Hill, of the U. S. Geological Survey, read a paper upon the names given by the Spanish people to the topographic features of the United States, illustrating by appropriate lantern slides. It was held that with one or two exceptions, Spanish words could be found upon the published maps for nearly all topographic forms. Over fifty of these terms were defined and illustrated, and Mr. Hill proposed that many of them be adopted into the English language and used for forms for which the latter possess no appropriate terms. The paper will be published in full.

W. F. MORSELL.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MAY 26, 1896.

A PAPER entitled 'Catalogue of the Species of Cerion, with Descriptions of New Forms,' by Henry A. Pilsbry and E. G. Vanatta, was presented for publication.

Mr. Edw. Goldsmith reported that a specimen of supposed Geyserite from Hawaii had been found by him to be an amorphous, soluble sulphate of lime. The substance was found on the edge of the crater of Kilauea, associated with sulphur deposits.

Prof. Edw. D. Cope exhibited the skull of a whale from the Miocene of the Yorktown epoch. It adds another species to the whalebone whales, and establishes their direct relations to the Zeuglodonts. The elongation of the parietal and frontal bones is characteristic. The form is allied to the genus *Cetotherium*, and is described under the name *Cephalotropis coronatus*.

Dr. M. V. Ball described a human exancephalic monster born in about the seventh month. The brain, although extruded, is well developed. There are six digits on one hand. No reason could be suggested for the occurrence, the parents, grandparents and a number of brothers and sisters being normal.

Botanical Section, May 11, 1896, Dr. Chas. Schaeffer, Recorder.—Mr. Thomas Meehan stated that he had observed that the flowers of *Draba verna* are often self-fertilized by the two long arcuate stamens, while in *Capsella*, of the same order, this is not the case. He believes *Draba* to be both protandrous and proterogenous.

Mr. Beringer exhibited a very tomentose specimen of *Quercus alba*, and gave new localities for *Carex baratii*.

A committee, consisting of Edw. D. Cope, Benjamin Sharp and H. Frank Moore, was appointed to draft resolutions for presentation to the next meeting expressive of the Academy's opinion on the subject of the anti-vivisection bill now before Congress.

EDW. J. NOLAN,
Recording Secretary.

NEW BOOKS.

Miscellaneous Papers by Heinrich Hertz, with an introduction by PROF. PHILIP LENARD, translated by D. E. JONES and G. A. SCHOTT. London and New York, Macmillan & Co., Ltd. 1896. Pp. xxvi+340. $3.25.

The Gypsy Moth. EDWARD M. FORBUSH and CHARLES M. FERNALD. Boston, Wright & Potter Printing Co. 1896. Pp. xii+495+C = 100.

Biological Experimentation, its Functions and Limits. SIR BENJAMIN WARD RICHARDSON. London, George Bell & Sons; New York, The Macmillan Co. 1896. $1.00.

SCIENCE

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SCIENCE

FRIDAY, JUNE 19, 1896.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ADDRESS OF THE PRESIDENT BEFORE THE SOCIETY FOR PSYCHICAL RESEARCH.**

THE Presidency of the Society for Psychical Research resembles a mousetrap. Broad is the path and wide the way that leadeth thereinto. Flattering bait is spread before the entrance: The distinguished names of one's predecessors in the office; the absence of any active duties; England and America symbolically made one in that higher republic where no disputed frontiers or foreign offices exist; and all the rest of it. But when the moment comes to retrace one's steps and go back to private life, like Cincinnatus to his plough, then comes the sorrow, then the penalty for greatness. The careless presidential mouse finds the wires all pointing against him, and to get out there is no chance, unless he leave some portion of his fur. So in resigning my office to my worthier successor, I send this address to be read across the ocean as my ransom, not unaware, as I write it, that the few things I can say may well fall short of the dignity of the occasion and the needs of the cause for which our Society exists.

Were psychical research as well organized as the other sciences are, the plan of a presidential address would be mapped out in advance. It could be nothing but a report

*Read at the Annual Meeting of the Society in London on January 31st, 1896, and also at meetings of the American Branch in Boston on January 31st and New York on February 1st, 1896.

of progress, an account of such new observations and new conceptions as the interim might have brought forth. But our active workers are so few compared with those engaged in more familiar departments of natural learning, and the phenomena we study so fortuitous and occasional, that two years must, as a rule, prove too short an interval for regular accounts of stock to be taken. Looking back, however, on our whole dozen years or more of existence, one can appreciate what solid progress we have made. Disappointing as our career has doubtless been to those of our early members who expected definite corroboration or the final *coup de grâce* to be given in a few short months to such baffling questions as that of physical mediumship, to soberer and less enthusiastic minds the long array of our volumes of *Proceedings* must suggest a feeling of anything but discouragement. For here, for the first time in the history of these perplexing subjects, we find a large collection of records, to each of which the editors and reporters have striven to attach its own precise coefficient of evidential value, great or small, by getting at every item of first-hand evidence that could be attained, and by systematically pointing out the gaps. Only those who have tried to reach conclusions of their own by consulting the previous literature of the occult, as vague and useless, for the most part, as it is voluminous, can fully appreciate the immense importance of the new method which we have introduced. Little by little, through consistently following this plan, our *Proceedings* are extorting respect from the most unwilling lookers-on; and I should like emphatically to express my hope that the impartiality and completeness of record which has been their distinguishing character in the past will be held to even more rigorously in the future. It is not as a vehicle of conclusions of our own, but as a collection of documents that may hereafter be resorted to for testing the conclusions and hypotheses of *anybody*, that they will be permanently important. Candor must be their very essence, and all the hesitations and contradictions that the phenomena involve must appear unmitigatedly in their pages. Collections of this sort are usually best appreciated by the rising generation. The young anthropologists and psychologists who will soon have full occupancy of the stage will feel, as we have felt, how great a scientific scandal it has been to leave a great mass of human experience to take its chances between vague tradition and creduilty on the one hand and dogmatic denial at long range on the other, with no body of persons extant who are willing and competent to study the matter with both patience and rigor. There have been isolated experts, it is true, before now. But our Society has for the first time made their abilities mutually helpful.

If I were asked to give some sort of dramatic unity to our history, I should say first that we started with high hopes that the hypnotic field would yield an important harvest, and that these hopes have subsided with the general subsidence of what may be called the hypnotic wave. Secondly, I should say that experimental thought-transference has yielded a less abundant return than that which in the first year or two seemed not unlikely to come in. Professor Richet's supposition that if the unexplained thing called thought-transference be ever real, its causes must, to some degree, work in everybody at all times (so that in any long series of card-guessings, for example, there ought always to be some excess of right answers above the chance number) is, I am inclined to think, not very well substantiated. Thought-transference may involve a critical point, as the physicists call it, which is passed only when certain psychic conditions are realized, and otherwise not reached at all—just as a big conflagration will break out at a certain temperature, below which no conflagration whatever, whether big or little, can occur. We have published records of experiments on at least thirty subjects, roughly speaking, and many of these were strikingly successful. But their types are heterogeneous; in some cases the conditions were not faultless; in others the observations were not prolonged; and generally speaking, we must all share in a regret that the evidence, since it has reached the point it *has* reached, should not grow more voluminous still. For whilst it cannot be ignored by the candid mind, it yet, as it now stands, may fail to convince coercively the skeptic. Any day, of course, may bring in fresh experiments in successful picture guessing. But meanwhile, and lacking that, we can only point out that our present data are strengthened in the flank, so to speak, by all observations that tend to corroborate the possibility of other kindred phenomena, such as telepathic impression, clairvoyance, or what is called 'test-mediumship.' The wider genus will naturally cover the narrower species with its credit.

Now, as regards the work of the Society in these latter regards, we can point to solid progress. First of all we have that masterpiece of intelligent and thorough scientific work—I use my words advisedly—the Sidgwick Report on the Census of Hallucinations. Against the conclusion of this report, that death apparitions are 440 times more numerous than they should be according to chance, the only rational answer that I can see is that the data are still too few, that the net was not cast wide enough, and that we need, to get fair averages, far more than 17,000 answers to the Census question. This may, of course, be true, though it seem exceedingly unlikely, and in our own 17,000 answers veridical cases may have heaped themselves unduly. So neither by this report then, taken alone, is it absolutely necessary that the skeptic be definitely convinced. But then we have, to strengthen *its* flank in turn, the carefully studied cases of 'Miss X.' and Mrs. Piper, two persons of the constitution now coming to be nicknamed 'psychic' (a bad term, but a handy one), each person of a different psychic type, and each presenting phenomena so chronic and abundant that, to explain away the supernormal knowledge displayed, the disbeliever will certainly rather call the subjects deceivers, and their believers dupes, than resort to the theory of chance-coincidence. The same remark holds true of the extraordinary case of Stainton Moses, concerning which Mr. Myers has recently given us such interesting documents. In all these cases (as Mr. Lang has well said of the latter one) we are, it seems to me, fairly forced to choose between a physical and a moral miracle. The physical miracle is that knowledge may come to a person otherwise than by the usual use of eyes and ears. The moral miracle is a kind of deceit so perverse and successful as to find no parallel in usual experience. But the limits of possible perversity and success in deceit are hard to draw; so here again the skeptic may fall back on his general *non possumus*, and without pretending to explain the facts in detail, say the presumption from the ordinary course of Nature holds good against their supernormal interpretation. But the oftener one is forced to reject an alleged sort of fact, by the method of falling back on the mere presumption that it can't be true because, so far as we know Nature, Nature runs altogether the other way, the weaker does the presumption itself get to be; and one might in course of time use up one's presumptive privileges in this way, even though one started (as our anti-telepathists do) with as good a case as the great induction of psychology that all our knowledge comes by the use of our eyes and ears and other senses. And we must remember also that this undermining of the strength of a presumption by reiterated report of facts to the contrary does not logically require that the facts in question should all be well proved. A lot of rumors in the air against a business man's credit, though they might all be vague, and no one of them amount to proof that he is unsound, would certainly weaken the *presumption* of his soundness. And all the more would they have this effect if they formed what our lamented Gurney called a faggot and not a chain, that is, if they were independent of each other, and came from different quarters. Now our evidence for telepathy, weak and strong, taken just as it comes, forms a faggot and not a chain. No one item cites the content of another item as part of its own proof. But, taken together, the items have a certain general consistency; there is a method in their madness, so to speak. So each of them adds presumptive value to the lot; and cumulatively, as no candid mind can fail to see, they subtract presumptive force from the orthodox belief that there can be nothing in any one's intellect that has not come in through ordinary experiences of sense.

But it is a miserable thing for a question of truth to be confined to mere presumption and counter-presumption, with no decisive thunderbolt of fact to clear the baffling darkness. And sooth to say, in talking so much of the merely presumption-weakening value of our records, I have been wilfully taking the point of view of the so-called 'rigorously scientific' disbeliever, and making an *ad hominem* plea. My own point of view is different. For me the thunderbolt *has* fallen, and the orthodox belief has not merely had its presumption weakened, but the truth itself of the belief is decisively overthrown. If you will let me use the language of the professional logic shop, a universal proposition can be made untrue by a particular instance. If you wish to upset the law that all crows are black, you mustn't seek to show that no crows are; it is enough if you prove one single crow to be white. My own white crow is Mrs. Piper. In the trances of this medium, I cannot resist the conviction that knowledge appears which she has never gained by the ordinary waking use of her eyes and ears and wits. What the source of this knowledge may be I know not, and have not the glimmer of an explanatory suggestion to make; but from admitting the fact of such knowledge, I can see no escape. So when I turn to the rest of our evidence, ghosts and all, I cannot carry with me the irreversibly negative bias of the rigorously scientific mind, with its presumption as to what the true order of nature ought to be. I feel as if, though the evidence be flimsy in spots, it may nevertheless collectively carry heavy weight. The rigorously scientific mind may, in truth, easily overreach itself. Science means, first of all, a certain dispassionate method. To suppose that it means a certain set of results that one should pin one's faith upon and hug forever is sadly to mistake its genius, and degrades the scientific body to the status of a sect.

But I am devoting too many words to scientific logic, and too few to my review of our career. In the question of physical mediumship, we have left matters as baffling as we found them, neither more nor less. For if, on the one hand, we have brought out new documents concerning the physical miracles of Stainton Moses, on the other hand we have, by the Hodgson-Davey experiments, and the Paladino episode, very largely increased the probability that testimony based on certain sorts of observation may be quite valueless as proof. Eusapia Paladino has been to us both a warning and an encouragement: an encouragement to pursue unwaveringly the rigorous method in such matters from which our *Proceedings* have never departed, and a warning against drawing any prompt inference whatever from things that happen in the dark. The conclusions to which some of us had been hastily led on 'the Island,' melted away when, in Cambridge, the opportunity for longer and more cunning observation was afforded. Some day, it is to be hoped, our *Proceedings* may be enabled to publish a complete study of this woman's life. Whatever the upshot of such a study, few documents could be more instructive in all ways for psychical research.

It is pleasant to turn from phenomena of dark-sitting and rathole type (with their tragi-comic suggestion that the whole order of nature might possibly be overturned in one's own head, by the way in which one imagined oneself, on a certain occasion, to be holding a tricky peasant woman's feet) to the 'calm air of delightful studies.' And on the credit side of our Society's account a heavy entry must next be made in favor of that immense and patient collecting of miscellaneous first-hand documents that alone has enabled Mr. Myers to develop his ideas about automatism and the subliminal self. In Mr. Myers' papers on these subjects we see, for the first time in the history of men's dealings with occult matters, the whole range of them brought together, illustrated copiously with unpublished contemporary data, and treated in a thoroughly scientific way. All constructions in this field must be provisional, and it is as something provisional that Mr. Myers offers us his attempt to put order into the tangle. But, thanks to his genius, we begin to see for the first time what a vast interlocked and graded system these phenomena, from the rudest motor automatisms to the most startling sensory apparition, form. Mr. Myers' methodical treatment of them by classes and series is the first great step towards overcoming the distaste of orthodox science to look at them at all.

But our *Proceedings* contain still other veins of ore for future working. Ghosts, for example, and disturbances in haunted houses. These, whatever else may be said of them at present, are not without bearing on the common scientific presumption of which I have already perhaps said too much. Of course, one is impressed by such narratives after the mode in which one's impressibility is fashioned. I am not ashamed to confess that in my own case, although my *judgment* remains deliberately suspended, my *feeling* towards the way in which the phenomena of physical mediumship should be approached has received from ghost and disturbance stories a distinctly charitable lurch. Science may keep saying: "such things are simply impossible;" yet, so long as the stories multiply in different lands, and so few are positively explained away, it is bad method to ignore them. They should at least accrete for future use. As I glance back at my reading of the past few years (reading accidental so far as these stories go, since I have never followed up the subject) ten cases immediately rise to my mind. The Phelps case at Andover, recorded by one of the family, in *McClure's Magazine* for this month; a case in China, in Nevius's *Demon Possession*, published last year; the case in John Wesley's life; the '*Amherst Mystery*' in Nova Scotia (New York, 1888); the case in Mr. Willis's house at Fitchburg, recorded in *The Atlantic Monthly* for August, 1868 (XXII., 129); the Telfair-Mackie case, in Sharpe's *History of Witchcraft* in Scotland; the Morse case, in Upham's *Salem Witchcraft;* the case recounted in the introduction of W. v. Humboldt's *Brief an eine Freundin;* a case in the *Annales des Sciences Psychiques* for last year (p. 86); the case of the carpenter's shop at Swanland, near Hull, in our *Proceedings*, Vol. VII., Part XX., pp. 383–394. In all of these, if memory doesn't deceive me, material objects are said to have been witnessed by many persons moving through the air in broad daylight. Often the objects were multitudinous; in some cases they were stones showered through windows and down-chimney. More than once it was noted that they fell gently and touched the ground without shock. Apart from the exceptionality of the reputed occurrences, their mutual resemblances suggest a natural type, and I confess that until these records, or others like them, are positively explained away, I cannot feel (in spite of such vast amounts of detected fraud) as if the case against physical mediumship itself as a freak of nature were definitively closed. But I admit that one man's psychological reaction cannot here be like unto another's; and one great duty of our Society will be to pounce upon any future case of this 'disturbance' type, catch it while red-handed and nail it fast, whatever its quality be.

We must accustom ourselves more and more to playing the *rôle* of a meteorological bureau, be satisfied for many a year to go without definitive conclusions, confident that if we only keep alive and heap up data, the natural types of them (if there are any) will surely crystallize out; whilst old material that is baffling will get settled as we proceed, through its analogy with new material that will come with the baffling character removed.

But I must not weary your patience with the length of my discourse. One general reflection, however, I cannot help asking you to let me indulge in before I close. It is relative to the influence of psychical research upon our attitude towards human history. Although, as I said before, Science taken in its essence should stand only for a method, and not for any special beliefs, yet, as habitually taken by its votaries, Science has come to be identified with a certain fixed general belief, the belief that the deeper order of Nature is mechanical exclusively, and that non-mechanical categories are irrational ways of conceiving and explaining even such a thing as human life. Now this mechanical rationalism, as one may call it, makes, if it becomes one's only way of thinking, a violent breach with the ways of thinking that have, until our own time, played the greatest part in human history. Religious thinking, ethical thinking, poetical thinking, teleological, emotional, sentimental thinking, what one might call the personal view of life to distinguish it from the impersonal and mechanical, and the romantic view of life to distinguish it from the rationalistic view, have been, and even still are, outside of well-drilled scientific circles, the dominant forms of thought. But for mechanical rationalism, personality is an insubstantial illusion; the chronic belief of mankind, that events may happen for the sake of their personal significance, is an abomination; and the notions of our grandfathers about oracles and omens, divinations and apparitions, miraculous changes of heart and wonders worked by inspired persons, answers to prayer and providential leadings, are a fabric absolutely baseless, a mass of sheer *un*truth. Now, of course, we must all admit that the excesses to which the romantic and personal view of Nature may lead, if wholly unchecked by impersonal rationalism, are direful. Central African Mumbo-jumboism in fact is one of unchecked romanticism's fruits. One ought accordingly to sympathize with that abhorrance of romanticism as a sufficient world theory; one ought to understand that lively intolerance of the least grain of romanticism in the views of life of other people, which are such characteristic marks of those who follow the scientific professions to-day. Our debt to Science is literally boundless, and our gratitude for what is positive in her teachings must be correspondingly immense. But our own *Proceedings* and *Journals* have, it seems to me, conclusively proved one thing to the candid reader, and that is that the verdict of pure insanity, gratuitous of preference for error, of superstition without an excuse, which the scientists of our day are led by their intellectual training to pronounce upon the entire thought of the past, is a most shallow verdict. The personal and romantic view of life has other roots besides wanton exuberance of imagination and perversity of heart. It is perenially fed by *facts of experience*, whatever the ulterior interpretation of those facts may prove to be; and at no time in human history would it have been less easy than now, at most times it would have been much more easy, for advocates with a little industry to collect in its favor an array of contemporary documents as good as those which our publications present. These documents all relate to real experiences of persons. These experiences have three characters in common: They are capricious, discontinuous and not easily controlled; they require peculiar persons for their production; their significance seems to be wholly for personal life. Those who preferentially attend to them, and still more those who are individually subject to them, not only easily *may* find, but are logically bound to find, in them valid arguments for their romantic and personal conception of the world's course. Through my slight participation in the investigations of the Society for Physical Research, I have become acquainted with numbers of persons of this sort, for whom the very word Science has become a name of reproach, for reasons that I now both understand and respect. It is the intolerance of Science for such phenomena as we are studying, her peremptory denial either of their existence, or of their significance except as proofs of man's absolute innate folly, that has set Science so apart from the common sympathies of the race. I confess that it is on this, its humanizing mission, that our Society's best claim to the gratitude of our generation seems to me to depend. We have restored continuity to history. We have shown some reasonable basis for the most superstitious abberations of the foretime. We have bridged the chasm, healed the hideous rift that Science, taken in a certain narrow way, has shot into the human world.

I will even go one step further. When from our present advanced standpoint we look back upon the past stages of human thought, whether it be scientific thought or theological thought, we are amazed that a Universe which appears to us of so vast and mysterious a complication should ever have seemed to any one so little and plain a thing. Whether it be Descartes' world or Newton's; whether it be that of the materialists of the last century or that of the Bridgewater treatises of our own; it always looks the same to us—incredibly perspectiveless and short. Even Lyell's, Faraday's, Mill's and Darwin's consciousness of their respective subjects are already beginning to put on an infantile and innocent look. Is it then likely that the Science of our own day will escape the common doom, that the minds of its votaries will never look old-fashioned to the grandchildren of the latter? It would be folly to suppose so. Yet, if we are to judge by the analogy of the past, when our Science once becomes old-fashioned, it will be more for its omissions of fact, for its ignorance of whole ranges and orders of complexity in the phenomena to be explained, than for any fatal lack in its spirit and principles. The spirit and principles of Science are mere affairs of method; there is nothing in them that need hinder Science from dealing successfully with a world in which personal forces are the starting-point of new effects. The only form of thing that we directly encounter, the only experience that we concretely have, is our own personal life.

The only complete category of our thinking, our professors of philosophy tell us, is the category of personality, every other category being one of the abstract elements of that. And this systematic denial, on Science's part, of personality as a condition of events, this rigorous belief that in its own essential and innermost nature our world is a strictly impersonal world, may, conceivably, as the whirligig of time goes round, prove to be the very defect that our descendants will be most surprised at in our own boasted Science, the omission that, to their eyes, will most tend to make *it* look perspectiveless and short.

But these things lie upon the knees of the gods. I must leave them there, and close now this discourse, which I regret that *I* could not make more short. If it has made you feel that (however it turn out with modern Science) our own Society, at any rate, is not 'perspectiveless,' it will have amply served its purpose; and the next President's address may have more definite conquests to record.

WILLIAM JAMES.

THE FORM OF THE HEAD AS INFLUENCED BY GROWTH.

THE change in the shape of the head which accompanies growth has been but very slightly investigated either in this country or abroad. The meagreness of results may be indicated by the fact that Topinard's Élements d' Anthropologie contains only a note upon the subject, with no data.* A recent investigation upon the students of the Massachusetts Institute of Technology may be of interest as bearing upon this question. The measurements covered 485 students, grouped as follows: 215 in the first-year class; 69 in the second; 66 in the third, and 136 in the graduating class.

From the comparison of the measurements of the length and breadth of the heads of these students so divided into classes, it appears that between the period of entrance and of graduation, that is to say from the ages of 18–19 to 23–24 years, the development of the head is almost entirely in respect of its length. The average breadth of the head remaining constant at or near 152 mm., the length varies from an average of 195.13 mm. in the first-year to 196.35 in the fourth-year class. The intermediate classes occupy a position midway between the two, indicating that this is not a result of chance. If this tendency be a general one, it means that the cephalic index in our American population of this class tends to decrease at this particular time of life. The cephalic index, for example, of the first-year students averages 78.6 and that of the fourth-year averages 77.2, the second and third years being 77.7. This is rendered specially significant by the fact that Drs. West and Porter have shown a slight decrease of cephalic index in American school children between the ages of 5 and 18; at Worcester, for example, the average index falling between 79 and 78.* If we assume that in both cases we are dealing with similar populations the hypothesis of a progressive decrease of cephalic index, with growth, of our American people would seem to be well founded.

In Europe, Zuckerhandl, comparing the index of 156 children and 197 adults of the same (Austrian) race, found that the children were narrower-headed than adults as a rule; and Holl confirms this result.† Dr. Meis declares that from his experience the children among the Germans are more dolicho-cephalic than the adults.‡ Schaaffhausen finds that in many cases the length

* Page 374.

* Archiv für Anthropologie, XXII., pp. 19 and 34; and Report of Anthropological Congress at Chicago, p. 57.

† Mitt. der Anth. Gesell. in Wien. XIV., 1884., p. 127; and *Ibid* XVIII., p. 4.

‡ *Ibid*, XX., 1890, p. 39 *seq.*

of the head is attained before the full breadth.* In Italy, Dr. Livi has brought together the results of a number of observers from both northern and southern Europe, but all of them from the broad-headed races.† The difference of cephalic index on the average among 447 cases here amounts to one unit in favor of broad-headedness of the adult, the contrary tendency to that noted for the Americans. That age brings a relative increase in the breadth of the head was also apparently indicated by the few measurements made by Welcker.‡ For Bohemia, Dr. Matiegka, from measurements on 400 children, asserted that there is no tendency toward a change in the relative length and breadth in the cases observed by him.§ Dr. Boas finds that in the North American Indians age is characterized by a relative increase in the length.||

On the whole, summarizing the results and opinions of these various writers, whose conclusions are, on the whole, contrary to our American ones, it appears that no universal rule can be established with respect to the effect of age upon the proportions of the head. The only hypothesis which seems to be confirmed by all this evidence is that development brings an approximation to the racial type most clearly marked in the adult. In other words, in the narrow-headed races, like our own, the children are broader-headed than the adults. Among the brachy-cephalic races, such as those instanced by Dr. Livi and most of the others cited, the children exhibit the race peculiarity in a less marked degree, that is, they are relatively narrower headed than at maturity. Finally the change from childhood to maturity becomes *nil* where the adults themselves belong to a group with a cephalic index near the mean for the entire European race. No relation can be established between the intelligence and the proportions of the head so far as the experience of European study goes, although Krause and Virchow declare in favor of the broad-headed type. If this hypothesis be true that age brings the fuller development of the race type, it may be possible in the future to apply a correction to the comparative results obtained by students of anthropology whose results are drawn from the study of children. But until that time the inferences to be drawn from such study are as likely to be erroneous as are conclusions drawn from the study of the color of the hair and eyes of school children, since in both cases maturity brings a change which has not as yet been statistically measured. It is earnestly hoped that further study along this line may be undertaken. The testimony of expert psychologists would be also of interest as bearing upon this point. In the hope of stimulating some such investigations, the modest results obtained from this study at the Institute of Technology are submitted.

W. Z. RIPLEY.

* Uber die Urform des Menschlichen Schädels, in report of Congres Int. d'Anth. et d'Archæologie, Paris, 1867.

† 'L 'Indice Cefalico degli Italiani,' Florence, 1886, p. 15.

‡ Archiv. für Anthropologie, I., p. 151.

§ Mitt. der Anth. Gesell. in Wien, XXII., 1892, Sitzungsberichten, p. 81.

|| Verh. der Berliner Gesell. fur Anth., Sitz ber. May 18, 1895, p. 392.

*IS THE PUMPKIN AN AMERICAN PLANT?**

IN the Index Kewensis seventeen species of the genus Cucurbita are recognized and their distribution given as follows:

C. bononiensis.	Hab.?	*C. maxima.*	As. trop. Orb. trop. cult.
C. californica.	Am. bor. occ	*C. medullaris.*	Hab.
C. ciceraria.	Chili.	*C. melanæformis.*	Japon.
C. digitata.	N. Mexic.	*C. moschata.*	As. trop.
C. ficifolia.	As. or.	*C. palmata.*	Calif.
C. fœtidissima.	Mexic.	*C. Pepo.*	Oriens. Afr. trop.
C. Galeottii.	Mexic.	*C. purpurea.*	Java.
C. hieroglyphica.	Hab.?	*C. radicans.*	Mexic.
C. lignosa.	Am. autr.		

* Substance of a lecture before University Archeological Association, Feb. 19, 1896.

According to the Index the two most important cultivated forms, *Cucurbita Pepo* and *C. maxima*, are looked upon as being natives of the eastern hemisphere and not of the western. Naudin, who made a careful and painstaking study of the cucurbits, is not so dogmatic. He says:* "De ces six espèces, trois sont alimentaires et cultivées depuis longtemps en Europe: ce sont *C. maxima*, *Pepo* et *moschata*, dont la patrie première est inconnue L'une d'entre elles, le *C. Pepo*, a peut-être été connue des Romains et des Grecs." De Candolle says† in relation to the original home of *Cucurbita maxima*: "Finally, without placing implicit faith in the indigenous character of the plant on the banks of the Niger, based upon the assertion of a single traveller, I still believe that the species is a native of the Old World and introduced into America by Europeans." In connection with this statement, the French botanist reviews the paper of Gray and Trumbull‡ and dissents from their views, because they were not based upon the observations of Naudin concerning the distinction existing between *C. maxima* and *C. Pepo*. The original home of *Cucurbita maxima* and *C. Pepo*, as far as I can discover from a cursory examination of the literature, is still doubtful, the Index Kewensis, however, throwing the weight of its influence towards an eastern origin. De Candolle* believes that *Cucurbita Pepo* is an American plant. He says: "Botanical indications are, therefore, in favor of a Mexican or Texan origin." "Thus historical data do not gainsay the opinion of an American origin, but neither do they adduce anything in support of it."

* NAUDIN, *Annales des Sciences Naturelles*, 4 Ser. VI., 15 ff.

†1885, DE CANDOLLE, *Origin of Cultivated Plants*, p. 253.

‡1883. GRAY AND TRUMBULL, *American Journal of Science*, p. 372.

According to Nuttall,* the Indians along the whole upper Missouri half a century ago were cultivating *C. verrucosa*. This common squash is according to Naudin a variety of *C. Pepo*, as is also *C. aurantia* (the *C. Texana* or *C. ovifera* of Gray), which has every appearance of being indigenous in the western part of Texas, on the Rio Colorado and upper tributaries. At least, this is the opinion of Mr. Lindheimer and Mr. Charles Wright, two good judges.

In looking over the plant materials collected in the undoubted prehistoric cliff dwellings of the Mancos Cañon, Colorado, and in identifying the vegetal specimens, as far as the material permitted, I became much interested in the seeds of some cucurbitaceous plant, which looked familiarly like those of the pumpkin. I was not satisfied, however, of this until I had made a somewhat detailed histological study. This was the more necessary, because the utmost confusion seems to reign as to the specific limits of several of the more interesting cultivated forms. There is not a group of plants the synonymy of which is more confused than that of the Cucurbits. Harz† and Borbas‡ give somewhat detailed descriptions of the anatomy of the seeds of *Cucurbita maxima* and *Pepo*, the former from an agricultural standpoint, the latter from a botanical. On comparing the seeds found in the cliff dwelling exhibit with the descriptions of both investigators, it was found that in every respect the seeds were those of the pumpkin *Cucurbita Pepo*. Space will not permit a detailed account of this investigation, but the results obtained indisputably prove that the pumpkin is a native of America. It is fortunate that the seeds were obtained from the ruins

* GRAY, *Scientific Papers*, I., p. 85.

† 1885, HARZ, *Landwirthschaftliche Samenkunde*, p. 795, 811.

‡ 1880, BORBAS VINCZE, *Földmüvelesi Erde Keink*, No. 52, quoted in *Botanische Centralblatt*, VIII. (?)

of a people who had no contact with Europeans, but who were undoubtedly pre-Columbian. Nor does the evidence of the American origin of the pumpkin solely rest upon the seeds discovered. A whole fruit with the stem intact is incorporated in the collection. Beside the fruit, we have the strongly ribbed stems of the fruit used by the cliff dwellers as stoppers for bottles. According to the distinction made by Naudin, the stem of *C. maxima* is smooth; that of *C. Pepo* is strongly fluted and roughly corrugated. So much for botanical evidence.

That the pumpkin is indigenous is shown also by the descriptions of the early explorers and settlers, and by the fact that gourds and pumpkins were used for a great many different purposes in America. This argues for an American origin, because it takes time for a people to learn new uses of a plant, which formerly may have served only one or two purposes. For example, among the cliff-dwelling Indians gourds, using the word in a general sense, were used for bottles, as receptacles to hold feathers and cotton down used in spinning. The stems were preserved and used as stoppers. The narrow neck of the gourd dipper, if accidentally broken off, was saved and used to hold the ceremonial pollen of maize or of the tule. The larger fruits were first dried, the interior cleaned out, and were then used as water pails or as receptacles in which to store corn (*Zea mays*), beans (*Phaseolus vulgaris*) and grass seeds. Mr. Cushing describes* the gourd water bucket of the Zuni as supported by wicker work composed of fibrous yucca leaves. These are a few of the many uses to which gourds were put before the advent of the white man.

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UNIVERSITY OF PENNSYLVANIA.

* 1882-83, CUSHING, *Report Bureau of Ethnology*, p. 483.

AWARD AND PRESENTATION OF THE RUMFORD PREMIUM.

IN conformity with the terms of the gift of Benjamin, Count Rumford, granting a certain fund to the American Academy of Arts and Sciences, the Academy is empowered to make, at any annual meeting, an award of a gold and silver medal, being together of the intrinsic value of three hundred dollars, as a premium to the author of an important discovery or useful improvement in light or in heat, which shall have been made and published by printing, or in any way made known to the public, in any part of the continent of America, or any of the American Islands: preference being always given to such discoveries as shall, in the opinion of the Academy, tend most to promote the good of mankind.

At the annual meeting of 1895 the Academy awarded the premium to Thomas Alva Edison for his investigations in electric lighting, and the presentation of the medals took place at the meeting of the 13th of May, 1896.

Vice-President Goodale, in presenting the medals, made the following remarks:

It would be highly presumptuous for one whose knowledge of physics is of the most elementary character to occupy the time of the Academy by any statement of his own in conveying these medals. Happily such a course is unnecessary. The Chairman of the Rumford Committee has placed at our command a brief statement which makes clear the ground of the award:

"The Rumford Committee voted, June 22, 1893, that it is desirable to award the Rumford medal to Thomas Alva Edison in recognition of his investigation in the field of electric lighting, and they confirmed this vote on October 9, 1893, in the following words: 'Voted for the second time to recommend to the Academy that the Rumford medal be awarded to Thomas Alva

Edison for his investigations in electric lighting.'

"The Committee reached the conclusion expressed by these votes after long deliberation and after careful sifting of all the evidence which was at their disposal in regard to Mr. Edison's claim for priority in the construction of the incandescent lamp, the conception of the central lighting station, together with the multitude of devices, such as the three-wire circuit, the disposition of the electric current feeders, and the necessary methods for maintaining the electric potential constant.

"The Committee felt that they could not decide upon Mr. Edison's claims for priority in any particular invention in this new industry. Indeed, courts of law after prolonged litigation have found it difficult to decide how far Mr. Edison was in advance of contemporary workers. The task given to the Rumford Committee to decide who is the most worthy of the Rumford medal, especially in the field of the application of electricity for the production of light and heat, is not an easy one. The number of investigators is now so large that it is no longer possible in general for one man to claim to be the first to apply electricity to a new field. The successful application is the result of many minds working on the same problem. Although the Committee did not feel justified in expressing the opinion that Mr. Edison invented the incandescent carbon filament lamp, or that he was the first to arrange such lamp in multiple on the circuit, thus producing what is popularly termed a subdivision of the electric light, or that the Edison dynamo had greater merits than the machine of Gramme and Siemens and others; still they are convinced that Mr. Edison gave a great impulse to the new industry and that he was the first to successfully install a central electric lighting plant with the multitude of practical devices which are necessary. They believe that this impulse was due to his indefatigable application, to his remarkable instinct in whatever relates to the practical application of electric circuits, and to his inventive genius. They, therefore, have unanimously recommended to the Academy to bestow the Rumford medals upon him, feeling that the work of Mr. Edison would especially appeal to the great founder of the medals, Count Rumford, if he were living."

The Academy has accepted the report of the Rumford Committee and has voted to confer the gold and the silver medal upon Mr. Edison. The recipient finds it impossible to be present at this meeting of the Academy and has requested Prof. Trowbridge to act as his proxy and to receive the medals for him.

In the name of the Academy I beg you, Prof. Trowbridge, to accept the charge of conveying these medals to Mr. Edison's hands. It would be most ungracious for us who are assembled in this room, which is flooded by this steady and brilliant electric light, to withold our personal thanks for what Mr. Edison's investigations and practical activities have done for us all. And, hence, I may venture to say that our thanks and all good wishes are to be conveyed with the Rumford medals.

Prof. Trowbridge replied as follows:

Mr. President and Gentlemen of the Academy: I accept the medals for Mr. Edison, and at his request I wish to express his deep sense of the great honor the Academy has conferred upon him. His work in the field of electric lighting has been the subject of prolonged litigation and at times he has had doubts in reading the opinions of learned experts whether this work has been original or whether he had really contributed anything to the world's progress. The recognition of his labors by the American Academy of Arts and Sciences, regarded by Count Rumford in his gifts as the coequal of the Royal Society of London, is therefore especially grateful to him. Acting as his proxy I thank the members of the Academy for the distinction which they have by their votes conferred upon him.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE preliminary announcement of the 45th meeting, to be held in Buffalo, August 22d to August 29th, calls attention to the fact that the Association met at Buffalo in 1866, 1876 and 1886, and to the special advantages of Buffalo as a place of meeting. Most of the meetings will be held in the Buffalo High School buildings,and the Hotel Iroquois has been designated as headquarters. The first meeting of the Council will be at noon on Saturday, August 22d, and the first General Session will be held on Monday morning, August 24th. This will give Tuesday, Wednesday, Thursday and Friday as the four days entirely devoted to the reading of papers in the sections. Saturday will be given to excursions.

The meeting will be called to order by the retiring President, Prof. Edward W. Morley, Adelbert College, who will introduce the President-elect Prof. E. D. Cope, University of Pennsylvania. An Address of Welcome will be delivered by Edgar B. Jewett, Mayor of Buffalo, Chairman of the Local Committee, who will be replied to by President Cope. The address of the retiring President will be given in the evening, and in the afternoon the addresses of the Vice-Presidents, as follows:

President Carl Leo Mees, of the Rose Polytechnic Institute, before the Section of Physics, on 'Electrolysis and some outstanding problems in Molecular Dynamics.' Miss Alice C. Fletcher, Washington, before the Section of Anthropology, on the 'Emblematic Use of the Tree in the Dakotan Group.' Prof. B. K. Emerson, Amherst College, before the Section of Geology and Geography, on 'Geological Myths.' Prof. W. E. Story, Clark University, before the Section of Mathematics and Astronomy, on 'Intuitive Methods in Mathematics.' Prof. William R. Lazenby, Ohio State University, before the Section of Social and Economic Science, on 'Horticulture and Health.' Dr. Theo. Gill, before the Section of Zoölogy, on 'Animals as Chronometers for Geology.' Prof. William A. Noyes, before the Section of Chemistry, on 'The Achievements of Physical Chemistry.' Prof. N. L. Britton, before the Section of Botany, on 'Botanical Gardens.' Prof. Frank O. Marvin, University of Kansas, before the Section of Mechanical Science and Engineering, on 'The Artistic Element in Engineering.'

It being designed to make of the Buffalo meeting practically a week of solid work, the Local Committees must, as far as possible, arrange the entertainment so as not to break in upon the business of Sections. Probably upon the evening of the first working day, Monday, August 24th, will be given the reception by the ladies of Buffalo, and a gentlemen's reception is to be appointed for some evening at the Buffalo Club. On another evening there will be a carriage drive or a moonlight ride upon Lake Erie, and the public lectures will fill out the complement of entertainment prior to the special trip of the session, which will be a general complimentary excursion for the Association to Niagara Falls, on Saturday, August 29th.

In addition to the magnificent natural scenery and its scientific aspects the power house of the Cataract Construction Company will be visited.

Several special excursions will be undertaken by the separate sections, and during the week preceding the meeting, parties will be conducted through western New York under the auspices of the Geological

Society of America. These excursions will be as follows:

Stratigraphy and Paleontology: Conductor, Prof. Charles S. Prosser, Union College. The purpose of this excursion will be to examine the several rock formations in western New York, with their characteristic fossils. The party will probably gather at Syracuse on Monday, August 17th, where the Salina, Helderberg, Oriskany and Onondaga strata are well shown. The Genesee ravine at Rochester, the streams entering the Genesee, and the gorge of the Genesee at Mt. Morris, will be especially studied.

Petrography: Conductors, Prof. James F. Kemp, Columbia University, and Prof. Charles H. Smyth, Jr., Hamilton College.

The party will meet at Port Henry on Lake Champlain, on Monday, August 17th, and spend two or three days under the guidance of Prof. Kemp, in the Lake Champlain valley and the eastern Adirondacks, visiting the quarries, iron mines, crystalline limestones, gabbros, anorthosites, bostonites and camptonites, and incidentally the Paleozoic exposures. They will then go by stage through the mountains to Lake Placid, where they will proceed by rail to Gouverneur. Prof. Smyth will conduct them to the talc mines, red hematite mines, contacts of gabbro and limestone, gneiss and other rocks of this vicinity.

Economic Geology: Conductor, Dr. F. J. H. Merrill, State Museum.

The excursion will meet at Syracuse and Rochester on Monday or Tuesday, and spend the week in a study of the mineral resources of the western part of the State. The subjects of study will be as follows: The salt fields at Syracuse and either LeRoy or Warsaw; the salt mines at Lehigh, Livonia or Retsof; the gypsum mines at Garbutt; the Medina sandstone quarries at Brockport, Albion or Medina; the 'marble' quarries at Lockport, the marl beds and cement works at Wayland; the waterlime cement works at Akron or Buffalo.

Pleistocene Geology. Conductors, Mr. G. K. Gilbert, United States Geological Survey, Mr. Frank Leverett, United States Geological Survey, and Prof. H. L. Fairchild, University of Rochester.

The area of western New York is an exceptionally interesting field for the study of glacial and glacio-lacustrine phenomena. The party will gather at Rochester on Monday, August 17th, and spend two days in that neighborhood in observation of the drumloids, kames and moraines, and the lacustrine phenomena of the glacial lakes Warren and Iroquois. Southwest of Batavia, Mr. Leverett will take the party over the Warren beaches and their correlating moraines. The study of Niagara gorge and related features will be left until the close of the Association meeting, when Mr. Gilbert will take charge of the party.

The affiliated societies meeting at Buffalo are as follows:

The Geological Society of America will hold its eighth summer meeting on Saturday evening, August 22d, at 8 o'clock, in the Lecture Hall of the Buffalo Society of Natural Sciences, basement of the Library Building. This meeting will be for administrative business and reading of papers by title. The papers will be presented and discussed in Section E during the following week. Joseph LeConte, Berkeley, Cal., *President;* H. L. Fairchild, Rochester, N. Y., *Secretary.*

The American Mathematical Society will hold its summer meeting in the Lecture Hall of the Society of Natural Sciences, Buffalo, on August 31st and September 1st. F. N. Cole, Columbia University, New York, *Secretary.*

The American Chemical Society will hold its thirteenth general meeting in Buffalo, on Friday and Saturday, August 21st and 22d, in room on the first floor of the High School. Dr. Charles B. Dudley Altoona, Pa., *President*; Dr. Albert C. Hale, Brooklyn, N. Y., *Secretary*.

The Society for the Promotion of Agricultural Science will hold its meetings in the Library Building, August 21st and 22d. Prof. Wm. R. Lazenby, Columbus, Ohio, *President;* F. M. Webster, Wooster, Ohio, and Herbert Osborne, Ames, Iowa, *Vice-Presidents;* Prof. Charles S. Plumb, Lafayette, Indiana, *Secretary*.

The Association of Economic Entomologists will hold its eighth annual meeting in the Library Building, August 21st and 22d. C. H. Fernald, Amherst, Mass., *President;* C. L. Marlatt, Washington, D. C., *Secretary*.

The Botanical Society of America will hold its second annual meeting in Buffalo High School, on Friday and Saturday, August 21st and 22d.

The Society will be called to order by the retiring President, William Trelease, of St. Louis, on Friday, at 3 P. M. The President-elect, Charles E. Bessey, of Lincoln, will then take the chair. The afternoon session will be devoted to business. At 8 P. M. the retiring President will deliver an address in the High School chapel; subject, 'Botanical Opportunity.' The sessions of the Society for the reading of papers will be held on Saturday, at 10 A. M. and 2 P. M., in room 16, High School. Prof. C. R. Barnes, Madison, Wisconsin, *Secretary*.

The Botanical Club of the Association will meet at 9 o'clock, Tuesday morning, August 25th, in the rooms assigned for the use of Section G (Botany). Frederick V. Coville, *President;* Prof. Conway MacMillan, *Vice-President;* J. F. Cowell, *Sec'y.* and *Treas.*

The Society for the Promotion of Engineering Education will meet in the rooms of the Engineers' Society of Western New York, Library Building, on Thursday, Friday and Saturday, August 20th, 21st, 22d. Prof. Mansfield Merriman, Lehigh University, *President*; Prof. C. Frank Allen, Massachusetts Institute of Technology, *Treasurer*.

CURRENT NOTES ON ANTHROPOLOGY.

THE BULL-ROARER, OR BUZZ.

THE value of the study of games and gaming implements to ethnology is well illustrated by a monograph which is printed in the last (ninth) volume of the Transactions of the 'Verein für naturw. Unterhaltung,' of Hamburg, by Prof. J. D. E. Schmeltz, the genial editor of the 'International. Archiv. für Ethnographie.' His subject is the familiar humming toy called by our boys the buzz (German, Schwirrholz or Waldteufel). Taking it up in the true scientific spirit, he sets about to study the various forms in which it has been made, the materials selected for its construction, the geographical localities in which its use has been reported, and the purposes for which it has been employed by various peoples. A plate is appended showing the various shapes which have been devised for it by different tribes. The result is that which is practically invariable when we examine with entire thoroughness any of these survivals from remote ancestral conditions: "We discover that one and the same implement was manufactured and connected with the same associations among tribes of the most widely different races. Does not this add another to the remarkable proofs that whether men have straight or crumpled hair, white or black skins, they are mentally so allied that their thoughts and even their follies are over and over again identically repeated?"

GEOGRAPHICAL MARKINGS ON NATIVE UTENSILS.

THE Brazilian explorer, Dr. Karl von den Steinen, calls attention in the *Ethnologisches Notizblatt*, No. 3, to a series of figures burned or scratched on the gourds used by the Lenguas Indians on the Paraguay river. They represent a number of circles connected by crooked lines. Their meaning would scarcely be guessed by an observer, but a native explained them as cartographical delineations, intended to indicate the locality where the utensil was manufactured, and the position and relative distances from it of the other villages occupied by the tribe.

This explanation seems to have valuable bearings in the interpretation of petroglyphs, and also of some of the curious markings on aboriginal pottery. It is likely that the same idea would be carried out on the soft surface of the pottery jar as on the exterior of the gourd. Some similar drawings of a topographic nature have been briefly discussed by Col. Garrick Mallery in his 'Picture Writings of the American Indians,' p. 341. D. G. Brinton.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

The international committee having in charge the work of the Astrophotographic Chart of the Heavens met in Paris on May 11th and the following days. The proceedings of the committee related principally to the technical details of the work. The reports of the directors of the various observatories taking part in the photographic work were, however, of considerable public interest. It appears from these reports that the series of plates from the measurement of which a catalogue of all the stars down to the eleventh magnitude is to be constructed have been practically completed at nearly all the participating observatories. The second series of plates, which are to be used simply as a chart, and which will include stars several magnitudes fainter than the smallest ones admitted to the great catalogue, is also well advanced. These chart plates require a much longer exposure than the catalogue plates, and for this reason it is not possible to finish them as quickly as the others.

The measurement of the catalogue plates has progressed with satisfactory rapidity at several of the observatories, so that we may expect the first instalment of the catalogue within a very few years. The final completion of it will perhaps require twenty-five or thirty years. The probable error of the final catalogue positions will be about one-tenth of a second of arc in either coördinate. H. J.

THE MISSOURI BOTANICAL GARDEN.

The seventh annual report of the Missouri Botanical Garden, recently issued, contains, in addition to the scientific papers, which we hope to notice later, the administrative reports for the year 1895. From these it appears that during the past year the maintenance revenue of the institution was $100,042.65, of which $86,698.09 was expended for the maintenance of the revenue property, taxes (amounting to nearly $25,000.00), and the maintenance and extension of the Garden.

It is stated that about one-third more people visited the Garden than during the previous year, on one day over 30,000 persons having been counted. As in the two preceding seasons, the growth of the Victoria Regia was made a prominent feature, and excited much interest. One of the most practical and direct benefits conferred by the Garden is indicated by the statement that, as in previous years, a considerable number of bedding plants were removed from the ground and potted on the approach of cold weather, and about 800 of these were distributed to hospitals, mission schools and similar charities, about half of the number going to the kindergartens of the public-school system. The provision for experimental work in horticulture and for the adequate instruction of pupils in gardening has been increased by the planting of a carefully selected orchard and the erection of a vegetable forcing house, built on the approved commercial models.

The herbarium has been increased by the incorporation of over ten thousand sheets of specimens, and now comprises some 242,000 specimens, besides over 4,000 slides, wood specimens, etc. During the past year, $3,764.00 was spent for purchases and binding for the library, which has been increased by 3,036 books and pamphlets during the year, so that, as now constituted, it consists of 10,030 pamphlets and 9,619 volumes. These facilities have been placed freely at the service of competent investigators, in a circular similar to one that was printed in this Journal a year since, and they have been used, as far as possible, in the botanical instruction of students in the School of Botany, of Washington University.

AGRICULTURE IN GREAT BRITAIN.

THE report of the British Board of Agriculture for 1895 is summarized in a recent issue of the New York *Evening Post*. It appears that the extent of woodlands in Great Britain is 2,726,000 acres, of which 132,000 acres have been planted in the last fifteen years. During the last year there has been a gain of about 30,000 acres. The most striking figures relate to the shrinkage in the amount of land under the plough, which was increased by the unpropitious character of the autumn seed time of 1894 and early spring of 1895. More than 510,000 acres less of wheat were grown, and 57,000 acres less of minor grain crops, rye, beans and peas. One-fifth part of the surface withdrawn from these crops or from wheat was devoted to barley and oats; but the corn land of 1895 was less by nearly 455,000 acres than that of 1894, while weather conditions, checking the preparation of the customary area for turnips and other green crops, caused a further reduction of 112,000 acres under this cultivation. The surface under potatoes, small fruit, lucerene and flax was larger by 45,000 acres, and the acreage left under bare fallow was extended by nearly 100,000 acres. The net reduction of arable land was 197,000 acres, and the net addition to the permanent pasture a little over 145,000 acres. The actual loss of arable area in the last two decades is 2,137,000 acres. The reduction of wheat-growing alone accounts for most of this loss. Under this head there was a total diminution of more than 1,900,000 acres between 1875 and 1895. More than a third of the decline in the arable area, and more than half of this reduction in wheat acreage, occurred in the last five years of the twenty. Statistics are given also of the imports of agricultural produce during the last twenty years. In value, the totals for 1895 exhibit increased imports of dead meat, poultry, eggs and lard. Live animals and dairy produce show slightly lower total values. Wheat and flour importations during the year amounted to more than £30,000,000, as against £26,755,000 in 1894, while other grain imports were reduced. The value of live animals imported represented £8,966,000, as against a total of £9,090,000 in 1894. The average animal importations has been more than £8,500,000 for the last ten years.

GENERAL.

DR. DAVID STARR JORDAN, President of Stanford University, has been appointed President of the Sealing Commission, which will go to Alaska on the steamer Albatross to study the sealing question. Drs. Leonhard Stegneger and F. A. Lucas, of the Smithsonian Institution, will accompany him. On the part of the government of the Dominion of Canada Mr. Andrew Hackett of the Fisheries Department, Professor MacGoun of the Geological Survey, and Professor Darcy Thompson, of Dundee, have left for British Columbia, on the way to Bering Sea.

THE expedition of M. Andrée embarked on June 6th from Gothenburg for Spitzbergen, from which place the expedition will proceed in the balloon.

LIEUTENANT PEARY, before starting on his expedition to the north coast of Greenland, has gone to England, his main purpose being to present an account of his important explorations in northern Greenland to the Royol Geographical Society.

MLLE. KLUMPKE, known for her work at the Paris Observatory, has been elected a member of the British Astronomical Association.

DR. LEOPOLD DIPPEL, director of the Botanical Gardens at Darmstadt, and professor of botany in the Technical High School, has retired.

A VALUABLE collection of animals and birds of Palestine, and of Roman coins, is offered for sale by Dr. Selah Merrill, of Andover (for many years United States Consul at Jerusalem).

THE Council of the British Medical Association has received an invitation to meet at Montreal in 1897.

THE *Lancet* states that a surgeon in the United States navy reports that in Japan among 1200 soldiers 1.58 per cent. were red blind, and 0.833 per cent. green blind. Among 373 boys 1 per cent. were red blind, and among 270 girls 0.4 per cent. Among 596 men in Kyoto 5.45

showed defective color sense. Dr. Fielde, of Swatow, China, examined 1200 Chinese of both sexes, using Thompson's wool tests. Among the 600 men were 19 who were color-blind, and among 600 women only 1. The percentage of color-blindness among Chinamen is then about 3 per cent., and does not vary greatly from that in Europeans. Dr. Fielde, however, found that fully half of those tested mixed up blue and green, and this investigator thinks that many of the race are quite blind to the violet colors.

THE thirty-first field meeting of the Appalachian Mountain Club will be held from July 3 to July 11, 1896, in the Crawford House, N. H. Sessions for the reading of papers and discussions will be arranged for evenings and for stormy days. Excursions will be made to the summit of Mount Washington and to Carrigain, Webster, Willard, Willey, Avalon, and other mountains, and possibly up the Mt. Washington river valley.

MR. E. WALTER MAUNDER, the astronomical editor of *Knowledge*, has arranged to visit Norway on board the steamship 'Norse King,' to observe the total eclipse of the sun on the 9th of August next.

THE recent tornado in St. Louis destroyed or seriously injured over 400 trees in the Missouri Botanical Garden, and several of the buildings were damaged; fortunately no harm was done to the herbarium and library. Shortly before the tornado 6,000 panes of glass were broken by a hail storm.

A PRIZE of $50 is offered by the editor of the Bulletins of American Paleontology, Prof. G. D. Harris, of Cornell University, for a monograph suitable for publication in the bulletins; it must be presented before May 1, 1897.

THE Société helvétique des sciences naturelle and the affiliated societies will meet at Zurich, from August 2d to 5th.

A BI-MONTHLY mathematical jounal to be edited by Prof. W. E. Storey, Clark University, is announced. The first number is now in the press and is expected to appear at once.

THE collection of American historical documents and other *Americana* made by Mr. T. A. Emmet has been presented to the New York Public Library; it is stated that the collection cost Mr. Emmet $300,000 and that Mr. J. S. Kennedy paid the collector $150,000. A friend of Yale University has purchased for the library a collection of 6,000 volumes and 19,000 pamphlets relating to Scandinavia.

A SIXTEENTH section, treating alcoholism, has been added to the Moscow International Medical Congress.

ACCORDING to *The British Medical Journal* the new physiological and pathological laboratories just opened at Queen's College, Belfast, are in every way excellent, and form a valuable addition to the resources of the Belfast Medical School. Dr. Lorrain Smith, lecturer on pathology, is conducting a post-graduate course on bacteriology, which is being largely attended and highly appreciated. The Council of the College, in accordance with the new regulations of the Royal University, have founded a new lectureship in public health. Dr. Whitaker, the General Superintendent Officer of Health for Belfast, has been appointed to the post. The lectures will be extended over three months.

DURING the spring term the class in field geology in Union College, accompanied by Prof. Prosser, has spent every Saturday in studying the different formations and interesting geological structure found within a radius of fifty miles from Schenectady. The formations studied range from the Laurentian up to the Hamilton of the Devonian. Some of the localities examined are the region of Saratoga Springs, and in the Mohawk Valley, Hoffman's, Amsterdam, Tribes Hill and 'the Noses' near Spraker's. At Saratoga, Hoffman's and 'the Noses' are excellent examples of fault structure, the latter place showing the Laurentian, Calciferous, Trenton and Utica formations. To the south of the Mohawk Valley, the eastern and northern flanks of the Helderberg Mountains and Howe's Cave were visited. This region gives an admirable section of the formations represented in eastern New York from the Hudson to near the summit of the Hamilton, and is also the typical locality for a number of them. As a result of this and earlier work of the department, valuable material and data have been obtained that will be used in preparing a report, revising the geology of this region.

SINCE our last issue news has reached us of the death of the eminent English physician, Sir Russell Reynolds, who died at London on May 29th at the age of 68. He was the President of the British Medical Association, and until lately President of the Royal College of Physicians and Professor of the Principles and Practice of Medicine in University College. He made important contributions to the scientific study of diseases of the nervous system, being one of the first to apply the statistical method. He was also the editor of the first 'English System of Medicine,' which appeared in five large volumes between 1866 and 1878.

CAPTAIN JOHN G. BOURKE, United States army, died in Philadelphia on June 8th. He had a brilliant record as a soldier, but deserves mention in this place owing to his contributions to anthropology and folk-lore. He was this year President of the Folk-lore Society. It is also proper to record in this JOURNAL the death of Mr. George Munroe, the New York publisher, not only on account of his generous gifts, which included $500,000 to Dalhousie College, Hallifax, but because he was from 1850 to 1856 instructor in mathematics in the Free Church College, Halifax.

M. DAUBRÉE, the eminent geologist, has died at the age of 82. He was from 1839 to 1855 a professor at Strasburg University, whence he was called to a chair at the School of Mines and the Natural History Museum, Paris.

WE regret that we must record in this issue an unusually large number of deaths of men of science. These include Dr. Finkelnburg, of Bonn, author of important works on hygiene; M. Raulin, professor of industrial and agricultural chemistry in the University of Lyons; Mr. Richard Sims, the antiquarian; Dr. Joseph Alexis Stolz, at the advanced age of 92, a native of Alsace, who was a professor at the Strasburg Faculty of Medicine till 1871, removed with the faculty to Nancy, and retired in 1880; Sir George Johnson, F. R. S., an eminent physician and professor of clinical medicine in King's College, at the age of 78; Dr. Hosius, of Münster, professor of mineralogy, at the age of 70; Professor Schickendantz, the chemist, at Buenos Ayres; Dr. Ludwig Mark, associate professor of agriculture at Königsburg, at the age of 56, and Dr. Wilhelm Hanke, sometime professor of anatomy at Tübingen, at the age of 62.

Natural Science notes that Mr. G. A. Boulenger is one of the first to use X-rays for purposes of systematic zoölogy, having used a skiagram to determine the more important points in the skeleton of the rare toad *Pelodytes caucasicus*, the second known species of the genus represented by a single specimen. The skiagram showed the junction of the astragalus and calcaneum, the form and extent of the fronto-parietal fontanelle, the shape of the widely-expanded sacral transverse processes and the direction of those of the lumbars.

THE *Lancet* states that an effort is at present being made to establish a museum in the historic city of Derry, Londonderry, and it is suggested that Gynn's Institution might be let for purpose of a museum at a nominal rent. There is a nucleus of a museum, which was some time ago handed over to Mr. Bernard, and at present the articles are being arranged in suitable cases. They are chiefly minerals. Moreover, several local gentlemen have private collections which would probably be forthcoming if a suitable habitation were obtained. Mr. Bernard, whose stock of relics and curios is a most valuable one, has expressed his willingness to give them to a local museum, and Sir J. A. MacCullagh has also a series of relics specially associated with the past history of Derry. It is hoped a building will soon be set apart for the museum.

UNIVERSITY AND EDUCATIONAL NEWS.

IT is announced in the daily papers that Sir Donald Smith will build in Montreal a Royal College for women, at a cost of $2,000,000.

MISS HELEN CULVER has added $25,000 to the $1,000,000 she had already given to the University of Chicago. This sum is to be added to the $300,000 set apart for the erection of four biological buildings.

THE class of 1876 of Princeton University has subscribed $15,000 towards the endowment of a McCosh professorship of philosophy.

THE scientific school of Harvard University will offer, during the summer, courses in surveying in Martha's Vineyard.

LIEUT. MURRAY, of the First Artillery, United States Army, has been appointed to succeed Capt. Pettit as professor of military tactics at Yale University.

IN addition to the fellowships in the scientific departments of Cornell University, announced in the last number of this JOURNAL, the following appointments have been made: In civil engineering, Stephen Gregory, C.E. (University of Texas); chemistry, Hector R. Carveth, A.B. (University of Toronto); physics, Arthur L. Foley, A.B., A.M. (University of Indiana). Twenty-two fellowships and sixteen scholarships are awarded annually at Cornell University.

DR. ARTHUR ALLIN has been appointed professor of psychology and pedagogy in the Ohio University at Athens.

THE *Naturwissenschaftliche Rundschau* announces the following appointments: Dr. Otto Fischer, associate professor in the University of Leipzig; Dr. Paul Eisler, full professor of anatomy in the University of Halle; Dr. L. Joubin, professor of zoölogy in the Faculty of Science at Rennes; Dr. H. Prous, professor of zoölogy in the Faculty of Science in Lille; Dr. J. A. Wislicenus, professor at the School of Forestry at Tarandt; Dr. G. Frege, full professor of mathematics at the University of Jena; Dr. H. Klinger, full professor of pharmaceutical chemistry in the University of Königsberg, and Dr. Scholl, assistant professor of chemistry at Karlsruhe.

THE following docents have recently been recognized in German Universities: Dr. v. Geitler, at Prague, for physics; Dr. Hans Batterman, at Berlin, for astronomy; Dr. Wagner, of Strasbourg, at Giessen, for zoölogy; Dr. J. Hofer, at the technical high school at Munich, for electrolysis, and Dr. Scholl, at Leipzig, for physics.

DISCUSSION AND CORRESPONDENCE.

THE HABIT OF DRINKING IN YOUNG BIRDS.

TO THE EDITOR OF SCIENCE: In response to a request that has just reached me, may I ask for space in your columns to say that the statement I made with regard to the habit of drinking in young birds was to the following effect? The chicks that I have observed pick instinctively at any small objects at suitable distance. If a small drop of water be such an object they will peck at that. But if a shallow tin of water be placed in their run the stimulus of the sight of still water does not evoke any instinctive drinking response. If there be grains of sand or food, or other objects at the bottom of the tin, they will peck at these and incidentally find the water. Sometimes they will peck at a bubble on the brim. Sometimes when one is thus led to drink others will follow by imitation. No sooner does the beak touch the water than, in the domestic chick, up goes the head and the instinctive drinking response is shown. I have seen ducklings waddle through the tin repeatedly and not stop to drink, though I had reasons for believing that they were thirsty; for when I dipped the beak of one of them beneath the water he drank eagerly and continued to do so for some time. On the other hand a little Moor hen or water hen, when I quickly lowered it at about 16 hours old into water, drank so soon as its breast touched the surface. It then swam off with instinctive definiteness of coördinated leg-movements.

The statement of fact (so far as my observations go) that I made was this: that the sight of still water evoked no instinctive response; but that the touch of water in the bill at once evoked the characteristic instinctive behavior.

C. LLOYD MORGAN.

A SUGGESTED EXPERIMENT ON HEREDITY.

As far as I have learned, there has been as yet no series of direct experiments on natural selection and heredity of acquired characters with adult animals. The success of Mr. Waller, President Cleveland's sporting friend, in baiting wild mallards with grain on platforms at different depths, so that the ordinary mallard is forced at length to dive six feet for its food, suggests that if such ducks were carefully thus trained, segregated and bred under scientific supervision, there might come some important results as bearing on the modification of structure by environment and on heredity. Fo example, we might expect increased webbing of the feet, and this might become hereditary.

HIRAM M. STANLEY.

LAKE FOREST, ILL., June.

DARKENING OF THE CATHODE IN A CROOKES TUBE.

A PEAR-SHAPED Crookes tube with a cathode disc in its narrow end has been used extensively by us during the past ten weeks in private experimentation and in public lectures on Röntgen rays. In common with many other experimenters, we have observed that after much usage the glass opposite the cathode disc and the glass about the anode became darkened. But we do not recall having seen any statement recorded regarding the darkening of the cathode disc. When we began using the tube the surface of the aluminium disc was uniformly bright throughout; now there is on the surface facing the broad end of the tube a dark brown ring concentric with the disc. This ring has an internal diameter of about 6 mm., and is darkest near its inner edge, the densest portion being, perhaps, 1 mm. across. Outside of this darkest portion the ring fades off gradually toward the outer edge of the disc. Taken as a whole, the internal and external diameters of the ring are about 5 mm. and 11 mm. respectively. The circular area inside of the dark ring is the brightest part of the disc. The diameter of the disc is about 17 mm.

During the discharge through the tube we now observe what we did not notice before, viz., a pencil of faint bluish light emanating from the circular area of the disc inside the dark ring. The pencil is normal to the disc. The light resembles the blue or purplish light about the anode. The cylindrical pencil is most distinct at the disc and gradually fades away and becomes invisible at a distance from it of about 2 or 3 cm. If, by reversal of the current, the disc is made the anode, then the pencil of blue light cannot be seen, but almost the entire tube is filled with the same purplish light. Sometimes this purplish light fills the tube also when the disc is used as a cathode. In such cases the discharge at the spark gap (placed in series with the tube) is fat and noisy; the tube shows very little fluorescence and the radiation of Röntgen rays is greatly diminished.

FLORIAN CAJORI,
WILLIAM STRIEBY,

COLORADO COLLEGE, COLORADO SPRINGS.

SCIENTIFIC LITERATURE.

Voice Building and Tone Placing, showing a method of relieving injured vocal cords by tone exercises. By H. HOLBROOK CURTIS, PH. B., M. D. D. Appleton and Company. 1896.

This latest claimant for favor in the difficult field of voice production will be found to contain much that is old to those familiar with the subject of acoustics and some that is as unexpected as it is new. The struggling pupil will find it difficult to extract the pearl of good advice from the shell of lengthy discussion. From the preface one can see that the author realizes at once the difficulty of the problem and what its solution should be, but it is doubtful if he has fulfilled the promise.

The author begins with a brief outline of the history of music, which is followed by a description of the anatomy of the larynx which is naturally all right, until he begins to discuss the operation of the various parts, and here certain discrepancies arise. For example, we are told that there is but one register, or rather that registers are 'fallacies,' and yet in attempting to discuss our control of pitch he refers to reaching a 'stage in the production of the lower register,' where, 'for any other further elevation of pitch, a complete rearrangement of the vocal apparatus is necessary.' Just exactly what the devotees of registers claim. In point of fact, however, if one has the proper use of the voice, the same muscles control the pitch from lowest to highest, without break or interruption.

The above is an example of the uncertainty in which the reader is left; registers are called fallacies, and yet they are discussed at length; they are assumed to exist and their fundamental differences in mechanism pointed out. Another statement which is very misleading, to say the least, is that air pressure in the lungs affects the pitch of the tone; "the pitch of the tone depends upon the strength of the expiratory pressure." How can we then take a tone piano, swell it to forte and diminish it again, without getting off the pitch?

In regard to respiration an elaborate discussion leaves one in doubt as to what method to use, unless it be a slightly amplified natural breathing, which is, of course, correct. The author seems an advocate of 'chest resonance' as being very efficacious, whereas, in fact, it is extremely difficult to see how vibrations in a closed cavity of constantly changing volume can be called resonance or can reinforce a tone. A cavity to reinforce a tone must have a definite volume and opening; it must be open to the air, else how could its resonance increase the intensity of the tone outside?

Vocal resonators and their importance are well emphasized and treated, except for the inclusion of the sinuses, antra and chest among the reinforcing cavities. The latter part of this chapter is especially good.

Under 'tones and overtones' a deal of acoustics is introduced which ought to be free from such ideas as that "a simple fundamental tone is not known in music," or that "there are also lower partials or undertones."

The chapter on registers is very peculiar and inconsistent, and some remarkable ideas as to the mutual action of the vocal cords and resonant cavities are put forward which will scarcely receive the approval of physicists, even though supported by a mass of supposed evidence furnished by the stroboscope. The author is continually referring to the voice as if it were the result of reeds or membranes. The voice has a mechanism to control the length, tension and weight of the vocal cords; these are the factors which control the pitch of a string. The overtones in the voice belong to the series in which the first overtone is twice the rate of the fundamental, the second three and so on. This is the series of string overtones. The pitch of a reed depends upon its length, thickness and elasticity; the larynx has no means of varying such factors. The series of overtones given by a reed is different from that experimentally found in the voice.

We are thus forced to consider the vocal apparatus as a stringed instrument. Under tone placing we find Dr. Curtis' specialty, 'nodules of attrition' and their cure. His idea is that the cords rub together, irritating each other, tearing each other, and even forming callous nodules. These he removes in a few hours by simple exercises. Other throat specialists have not observed these phenomena'; and indeed how shall we believe a ragged or callous vocal cord could be cured by any exercises in a few hours. These ideas are fortified with numerous cuts of photographs of the vocal cords that associate none too well with the author's caustic remarks about touching up photographs to meet 'preconceived requirements.' Some of the advice given in this chapter is, however, worthy of approval.

It is rather remarkable that, after an elaborate discussion of the larynx, and breathing and the rest, the author should quote with evident approval Jean de Reske's epigrammatic statement that, '*la grande question du chant devient une question du nez.*' All we can do with the nose is to leave it open.

The chapter on voice building doubtless contains many good exercises and much good advice, inspired as it was by such a master of tone production as Madame Melba. The concluding chapter on voice figures contains numerous pretty pictures and interesting matter which is, however, foreign to the subject of the book.

There is much that is good in the book, but a desire to give a full discussion often leaves one in serious doubt as to the correct conclusions and renders it difficult for a novice to discriminate between the good and the bad.

W. HALLOCK.

Grundriss der Krystallographie für Studirende und zum Selbstunterricht. By DR. GOTTLOB LINCK, Professor of Mineralogy at the University in Jena. Jena, Gustav Fischer. 1896. 8°. VI. and 255 pp. 2 colored plates and 482 figs.

Although the best treatises in crystallography are to be found in the German language, elementary text-books on the subject are as rare in Germany as in England or America. It is true that in nearly all books on mineralogy the principles of crystallography are discussed to some extent; and that occasionally the discussion is of value to the student. But in the great majority of cases it serves merely to bother him and to give him a distaste for that most beautiful of all geometrical sciences—the study of the exact forms assumed by crystallizing substances.

In the little volume before us the author has endeavored to give the beginner in crystallography an insight into the subject in its various branches. The book occupies the same place in German scientific literature as does Dr. Williams's *Elements of Crystallography* (Holt & Co.) in English literature. It goes further than the latter book, however, in that it treats of the physical as well as of the geometrical properties of crystals.

The order of treatment in the volume is not quite as logical and consecutive as one would wish it to be in an elementary text-book. It opens with an 'Introduction' in which the general principles of geometrical crystallography are described (rather than discussed). In this portion of the book such subjects as coördinated axes, symmetry, zonal equations, parallel growths, twinned crystals and pseudomorphs are explained, some of which, it would seem, might better have been left unexplained until the student had mastered the characteristics of simple crystals.

The discussion of the six crystal systems occupies 132 pages—about one-half the volume. The discussion of each begins with a brief study of the symmetry of the holohedral forms; then follow the descriptions of the individual forms and of their simple combinations; and in conclusion the description of the hemihedral and tetartohedral forms. The derivation of the partial forms from the holohedral ones is not emphasized as it is in Williams's book. They are treated rather as forms in which certain planes of symmetry have disappeared.

The last 100 pages are devoted to an outline treatment of physical crystallography. The figures used here are well chosen to illustrate the text. All of them are fresh and some are entirely original. This portion of the volume deserves more extended notice than can be given it in this place, not because the subject-matter is startling in its novelty, but because the subject of which it treats is made so little of in this country, whereas, in reality, familiarity with it is indispensable to a true knowledge of the properties of crystals.

The chapters on hardness, etching and optical properties are especially interesting. Here more particularly than elsewhere will the student wish that the author had explained the logic of the conclusions reached through the study of the phenomena described. The chapter on the optical properties of crystals covers this difficult branch of crystallography in a very satisfactory general manner. The treatment is not full enough to enable the student to understand the optical methods of studying crystals, but it is sufficiently thorough to enable him to understand the principles upon which the methods are based.

The magnetic, electrical and thermal properties of crystals are next briefly referred to, and the volume closes with a condensed statement of the relations existing between crystals and their chemical composition.

On the whole, the book is an excellent introduction to modern crystallography; it is certainly the best book of its kind published in any language, and yet one cannot help feeling that the author has not produced a book that will serve 'für Studirende und zum Selbstunterricht.' In the hands of an instructor it should unquestionably serve a useful purpose and should make an excellent textbook.

The colored plates illustrate the appearance of the axial figures of crystals, the dichroism of tourmaline, etc., and the pyro-electrical properties of quartz, boracite and struvite.

W. S. B.

Chermotheca Italica Continens Exsiccato, in Situ, Coccidarum Plantis, Precipue Cultis, in Italia Occurrentibus, Obnoxiarum. Cocciniglie raccolte in Italia. Fascicolo I. PROF. ANTONIO BERLESE e DR. LEONARDI GUSTAVO. Portici. 1896. Lire 10.

For a number of years sets of dried fungi have been published by mycologists in this country and abroad. The earliest works of this description were issued in Europe. The first distinctively American effort in this direction, as I am informed by Mr. B. T. Galloway, was made by H. W. Ravenel, of South Carolina, who published his Fungi Caroliani Exsiccati from 1852 to 1860. Other writers, especially Mr. J. B. Ellis, Messrs. Seymour & Earle, and, in Italy, Briosi and Cavara, have carried forward this excellent work.

Nothing of the kind has heretofore been done in entomology, and, in fact, it is only in the case of scale insects that this method of publication is possible. Quite recently Dr. A. Berlese and Dr. G. Leonardi, of the Superior School of Agriculture in Portici, have begun the publication of a series of Coccidæ based upon the mycological method. The first number, which has just been issued, contains in a large octavo volume, 25 species of Italian Coccidæ of economic importance. The form of the work is exceptionally pleasing. The printed matter comprises title page, index and the full synonomy and bibliography of each species. An entire sheet is given to each species and a sufficient number of specimens in situ on the leaf or bark, as the case may be, are folded into a commodious pocket. This publication, for certainly it must be called a publication, will be greeted with great pleasure by all economic and systematic entomologists. Nothing could be done which would better facilitate the labors of both classes of workers. A number of the synonyms appear surprising, but there is at present no reason to doubt their correctness. For example, *Parlatoria pergandei* Comstock, a well known enemy of citrus trees in Florida and Louisiana, is according to the authors, identical with the European *Parlatoria proteus* of Curtis; *Mytilaspis citricola* Comstock, nec Packard, becomes a synonym of *Mytilaspis fulva* Targioni Tozzetti; and for the California red scale of the orange the authors have erected a new genus, *Aonidiella*, the full description of which appears in Berlese's 'Italian Coccidæ living upon Citrus Plants,' Part III. L. O. Howard.

Hypnotism, Mesmerism and the New Witchcraft. By Ernest Hart. New Edition. New York, D. Appleton & Co. 1896. Pp. 212. 8°.

The demand for a second edition of Mr. Hart's book within three years after its first appearance is a welcome indication that although, as Mr. Hart strikingly illustrates, 'Populus vult decipi,' a small portion of the public at least is willing to be undeceived. The main object of the volume is to inspire a reaction against the current uncritical and pernicious devotion to a certain obscure and semi-morbid portion of psychic phenomena. Hypnotism and faith-cure and telepathy and 'Psychic Research' have been seized upon by men and women without special fitness or training for such study, and have become to these well-meaning but misguided adepts a form of new witchcraft. Not only they, but men of scientific training and wide reputation, have contributed to the general mass of error by carelessness in experimentation, and by a lack of a realization of the vast possibilities of intentional deception and unconscious self-deception inherent in such investigations. The sensational and extravagant experiments of Dr. Luys, in which he claimed to have demonstrated the action of a magnet upon hypnotized subjects, the transference of sensations from a doll to a subject, the mysterious influence of sealed drugs acting at a distance, and the like, are particularly well 'exposed' by Dr. Hart. Wooden magnets and 'unmagnetized dolls' and drugs called by false names were found to be equally effective if only the subject believed them to be what they purported to be.

The main addition to the present edition of this series of essays is the one entitled 'The Eternal Gullible,' which contains a very remarkable account of the methods pursued by by public 'hypnotists,' in London, for obtaining bogus subjects. There seems to be a training school where young men with dull moral and physical sensibilities are taught to endure the pain of needles thrust through the cheek and fingers, to drink paraffin mixture, to sing a comic song, act any part assigned by the hypnotist, 'do catalepsy,' and the like. Mr. Hart's evidence is complete and convincing, but it seems rather strange that such methods should be resorted to when the training of genuine hypnotic subjects to do these things is so simple a matter.

While the general trend of Mr. Hart's volume is to be warmly commended, it will probably weaken its own cause by its slight but appreciable overstatement. Mr. Hart records his belief in the reality of the hypnotic state and in the existence of valid and scientific investigation of such states, but the admission is hardly prominent enough to prevent the reader from forming the notion that all hypnotic research is humbug and deception. Indeed, in the preface to the second edition, Mr. Hart goes so far as to say "Hypnotism, when it is not a pernicious fraud, is a mere futility which should have no place in the life of those who have work to do in the world." Such a statement entirely overlooks the large number of critically authenticated cases of the therapeutic application of hypnotism; it ignores the significant and important contributions to the understanding of psychological principles that have sprung from this study. As a popular fad or amusement such topics are certainly pernicious in the extreme; but it will hardly do to associate with this the painstaking and scientific investigations of able and discerning experts.

JOSEPH JASTROW.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, JUNE 4, 1896.

MR. ASHMEAD exhibited a specimen of the genus Cardiochiles, of Nees, and announced its identity with Say's genus Toxoneura. It has priority and forms the type of a subfamily distinct from the Microgasterinæ.

Mr. Howard exhibited specimens of an adult and cocoon of *Attacus jorulla* Westwood, to which he had referred in a note in SCIENCE, of May 29th.

Mr. Schwarz exhibited specimens of *Atimia confusa* Say, a Longicorn beetle previously taken in the Lake Superior region, District of Columbia and northern Texas, the food habits of which were unknown until recently. He had found it attacking Juniper in the District of Columbia. He also exhibited specimens of *Lachnosterna cribrosa* from Texas.

Mr. Marlatt presented a paper entitled 'Notes on Texas Insects,' relating to some of the common insects of southwestern Texas which he had collected in April and May of the present year. The collecting had proved to be poor, owing to a severe protracted drought, and was only fair in such of the arroyos as had not been pastured by stock.

Mr. Schwarz presented for publication a paper entitled 'Notes from Southwestern Texas, No. IV; Food-plants and habits of some Texan Coleoptera,' in which he particularly described the coleopterous fauna of the Mesquite and Cactus. In discussing this paper Mr. Marlatt referred to the flowering Opuntias of the dry plains of Colorado and Kansas as affording extremely rich collecting fields, while the same plants in southern Texas did not offer the same opportunity to collectors. This was explained by Mr. Schwarz as due to the fact that the Mesquite and Opuntia flower simultaneously in Texas, and the former proves more attractive to the insects and draws them away from the Cactus. Some discussion ensued upon the superstitions regarding various insects pervading southwestern Texas, some of which were said by Mr. Schwarz to be probably of very ancient origin. Both the speaker and Mr. Marlatt referred to the dread of the inhabitants of the common *Pasimachus californicus* and *P. duplicatus*. These harmless ground beetles are known to the Mexicans as the 'cucurazza' and are supposed to be extremely poisonous, while in certain localities the English-speaking people know the Pasimachus as the 'shear-bug' and state that it is very injurious to grapevines and vegetables by cutting young plants, a statement which is fully as erroneous as the one made by the Mexicans.

L. O. HOWARD,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE eighty-eighth regular meeting was held Thursday, April 9, 1896. The Society was called to order at 8 p. m. by the President, Dr. A. E. de Schweinitz, with thirty members and ten guests present. The first paper was by Mr. V. K. Chestnut upon 'Some Vegetable Skin Irritants and their Chemical Composition.' The paper consisted of a review of the work of Dunstan and Miss Boole on croton oil, and of Pfaff on Toxicodendrol—a new oil-like body from the poison ivy, Rhus radicans; together with an account of some vesicating plants which have been but little studied. Specimens of this plant were exhibited, and the effect of an alcoholic solution of lead acetate as an antidote to

Rhus poisoning was illustrated by experiments carried out by the writer on himself. These experiments also showed conclusively that toxicodendrol was the vesicating principle of the poisonous species of Rhus.

Mr. Ewell read the second paper of the evening on 'The Effect of Acidity on the Development of the Nitrifying Organs,' by E. E. Ewell and H. W. Wiley. While it has been known for many years that active nitrification occurs only in the presence of some basic substance capable of neutralizing the free acid as fast as it can be formed, very little time has been devoted to the study of the exact degree of acidity that the nitrifying organisms can endure. As the authors had some forty samples of soil at their disposal during the last year for other purposes, it seemed wise to improve the opportunity to test the influence of acidity on the nitrifying organisms contained in the soils from various parts of the country. Tests were made with forty-four different soils, from twenty-two States and Territories. The results showed great uniformity in the relation to acidity of the organisms contained in the various soils. Excluding five tests in which no nitrification, and five tests in which it was excessive because of the calcareous nature of the soils used for the seeding of the cultures, the average amount of nitrogen nitrified was twenty parts per million; the minimum result of the thirty-four tests included in this average was eleven, and the maximum twenty-five parts per million. The tests are to be repeated with pure cultures of the nitrifying organisms of the same soils. This series of experiments was made as a study of the nitrous organisms only, but the results show that the organisms are not more sensitive to acidity than the nitrous organisms, the final product being nitrate in nearly every case.

The third paper was on 'The Chemistry of the Cactaceæ,' by E. E. Ewell. Until very recently other species of cacti than *Cereus grandiflorus* and a few related species have generally been regarded as devoid of constituents of pharmacological value. These and other species have been used in medical practice in the countries in which they grow, but their use has rarely extended to the more civilized nations. Species of the genus *Anhalonium* have long been used for curative and ceremonial purposes by the Indians of Mexico and the southwestern parts of our own country. They found place in the Mexican pharmacopeia of 1842, under the name of 'pellote,' or 'Peyotl,' but have been omitted from the later editions. The dried aërial portions of species of *Anhalonium* figure in the commerce of our southwestern border under the name of 'mescal buttons.' The species of this genus have been the subject of scientific investigation by at least three groups of persons during recent years: First, a group of persons at Berlin, where the work was begun by Dr. L. Lewin, the crude material being supplied to him by Messrs. Parke, Davis & Co., of Detroit; second, a group of persons at the Pharmacological Institue at Leipzic, where the work has been conducted by Dr. Arthur Heffter; third, a group of persons in this country, centering in the Bureau of American Ethnology and including as associates the Division of Chemistry of the United States Department of Agriculture for chemical studies, Drs. Prentiss and Morgan for a study of physiological properties, and the Botanical Division of the United States Department of Agriculture for the settlement of botanical questions.

In this country the separation of the constituents of these plants, and the study of the action of the substances thus obtained, as well as of the crude materials, upon men and the lower animals, were begun in the autumn of 1894, but before receiving the paper of Heffter. *A. lewinii*, in the form of 'mescal buttons,' has served as the material for these studies. Anhalonin and a second alkaloid have been separated in considerable quantity. A complete chemical study of the constituents of the plant is in process, including those substances of interest to the vegetable physiologist as well as those of interest to the therapeutist. The paper was illustrated with specimens of the cactus of different varieties from the Botanical Gardens and the Department of Agriculture.

Mr. Mooney followed with a paper on 'The Mescal Ceremony among the Indians.' The mescal plant is a small variety of cactus, native to the lower Rio Grande region and about the Pecos River in eastern New Mexico. The botanical name has finally been fixed by Prof. Coulter as *Lophophora Williamsii.* Mescal is the name by which it is known to the Indian traders, but it is not to be confounded with the other mescal (Maguey) of Arizona. The local Mexican name is *peyote*, a corruption of the original Aztec name, from which it would seem that the plant and ceremony were known as far south as the valley of Mexico, at a period antedating the Spanish conquest. Several closely related species are described by Lumholtz as being used with ceremonial rites among the tribes of the Sierra Madre. The dried tops, when eaten, produce such marked stimulating and medicinal results and such wonderfully beautiful psychologic effects, without any injurious reaction, that the tribes of the region regard the plant as the vegetable incarnation of the Deity, and eat it at regular intervals with solemn religious ceremony of song, prayer and ritual. The ceremonial and medicinal use of the plant was first brought to public notice by James Mooney, in a lecture delivered before the Anthropological Society of Washington in 1891, as a result of studies made among the Kiowas and associated tribes of western Oklahoma. As the ceremony is forbidden, and the trade in the plant made contraband upon the reservations, the investigation was a matter of some difficulty. In 1894 Mr. Mooney brought back a large quantity of the dried mescal, which was turned over to the chemists of the the Agricultural Department for analysis, and to Drs. W. F. Prentiss and F. P. Morgan, of Washington, for medical experimentation. The results thus far would seem to indicate that the Indians are right in asserting that they have discovered in the mescal a valuable medicine entirely unknown to science, and which will probably take its place in our pharmacopeia along with those other Indian remedies, quinine and coca. The ceremony and songs were briefly described by Dr. Mooney, whose full investigation of the subject will ultimately appear in one of the publications of the Bureau of American Ethnology.

Dr. Francis P. Morgan followed with a paper on the "Physiological Action and Medicinal Value of *Anhalonium lewinii* ('Mescal Buttons')." Dr. Morgan stated that the investigation had been intrusted to Dr. D. W. Prentiss, with whom he was associated. Experiments were tried and observations taken at regular intervals to determine the action of the entire button on the system. The most striking result was the production of visions of the most remarkable kind with the eyes closed, and especially so in the dark. Changes of color were characteristics; tubes of shining light, figures, cubes, balls, faces, landscapes, dances and designs of changing colors were among the most persistent visions. They were hardly seen with the eyes open; in full dose no effect on the reason or will is noticed in most cases. There was direct stimulation of the centers of vision and dilatation of the pupils. About one quarter of the quantity, or three buttons, are sufficient to give the visions in the case of white men. Dr. Morgan detailed the experiences of different persons who had tried the experiments. In some cases there was slowing of the heart, from 75 to 45 beats, followed by a rise to normal; there is also inability to sleep, and a loss of the sense of time, hours seem to intervene between words. The physiological action is not identical with that of any known drug; it is unlike cannabis indica, cocaine, etc. The constituents of the mescal buttons are being experimented with, but the investigations are still incomplete. Anhalonine causes increased reflex irritability and convulsions, like strychnine. It is, however, evidently not the active principle. Another constituent has been isolated whose action is widely different. It does not cause opisthotonos nor tetanus, and has no action like that of strychnine. A third principle has also been isolated. The resin is supposed to be the active principle and will probably be of use in medicine. The experiments are still being conducted and will be detailed later on.

A. C. PEALE,
Secretary.

CHEMICAL SOCIETY OF WASHINGTON.

THE eighty-ninth regular meeting was held Thursday, May 14, 1896. President Dr. de Schweinitz in the chair; twenty-three members present. Messrs. Mayville W. Twitchell and Charles N. Forrest were elected to membership. The Society adopted an address to the

Senate of the United States, protesting against the enactment of any legislation upon the subject of vivisection. The following papers were read: 'Practical Analytical Accuracy,' by Frederic P. Dewey; 'A new Mode of Formation of Tertiary and Quaternary Phosphines,' by P. Fireman; 'Metaphosphimic Acids,' by H. N. Stokes.

The Society adjourned until November.

A. C. PEALE,
Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, JUNE 2.

PROF. EDWARD D. COPE made a second report on his study of the remains of extinct animals found in the Port Kennedy Bone-Fissure. Five species of reptiles and three of birds had been found while forty species of mammals, the distribution of which was given, had been determined. *Megalonyx Wheatleyi* is represented by at least fifty-five individuals, the cave bear being of the next most frequent occurrence, remains of twenty-five individuals having been collected and twelve of the mastodon, the latter mostly young. *Mylodon* is not included in the list, although a trace of its presence was found on the occasion of an earlier exploration. Evidence was at hand that *Megalonyx dissimilis* had been founded on the lower teeth of *M. Jeffersonii.* An evolutionary series of the teeth of *Phenacodus, Fiber, Isodelta* and *Microtus* was described. A porcupine formerly regarded as distinct may belong to an existing species. Four species of skunks of two distinct genera, one of them new, *Osmotherium, rectangulare,* were described. A tooth formerly described as belonging to a hyæna must be referred to *Uncia Merceri.* The horse of the collection is *Equus complicatus.* Other species indicated by the remains were described and classified. Only seven of the forty-eight species determined can be said to be the same as existing forms. The opossum and raccoon are entirely absent, although abundantly present in the Post-Champlain caves. A Tennessee cave had recently been proven by Mr. Mercer to be intermediate between that at Port Kennedy and those of more recent date. It contained no remains of man.

The age of the Port Kennedy Fissure was debated by Messrs. Heilprin and Cope.

Dr. Harrison Allen described an interesting skull of a young Sandwich Islander from which some of the teeth on the left side had been knocked out at maturity, probably in commemoration of the death of a chief. The superior maxilla of the edentulous side exhibits osteoporosis and the temporal muscle was evidently weakened. Other evidences of the effect of disuse even after maturity had been attained were pointed out, furnishing an important illustration of the effect of nutrition and external agencies on structure.

Mr. F. J. Keeley exhibited microscopic preparations of a fragment of supposed jade taken from a carved Mexican figure in the Museum of the Academy and others of genuine jade for comparison. The Mexican mineral was found to possess none of the characters of true jade. The subject is of importance from an ethnological point of view.

EDW. J. NOLAN,
Recording Secretary.

NEW BOOKS.

Elementarcurs der Zootomie in fünfzehn Vorlesungen. DR. B. HATSCHEK and DR. C. J. CORI. Jena, Gustav Fischer. 1896. Pp. viii+103. M. 6. Pp. 50.

Sporozoenkunde Ein Leitfaden für Aerzte und Zoologen. DR. VON WASJELEWSKI. Jena, Gustav Fischer. 1896. Pp. vii+162. M. 4.

Lehrbuch der ökologischen Pflanzengeographie. DR. EUGEN WARMING. Berlin, Gebrüder Borntraeger. 1896. Pp. xii+412.

The Magnetic Circuit in Theory and Practice. DR. M. DU BOIS, translated by DR. ATKINSON. Longmans, Green & Co., London, New York and Bombay. 1896. Pp. xviii+366.

The Gypsy Moth. EDWARD M. FORBUSH and CHARLES H. FERNALD. Boston, Wright & Potter Printing Co. 1896. Pp. xii+495+c.

Indiana, Department of Geology and Natural Resources. W. S. BLATCHLEY. Indianapolis, State Printer. 1896. Pp. vi+520.

Missouri Botanical Garden. Seventh Annual Report. St. Louis Mo., Published by the Board of Trustees. 1896. Octavo pages 1–209, plates 1–66, and 6 unnumbered plates.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

FISHES, LIVING AND FOSSIL.

A TEXT-BOOK of Ichthyology embodying the results of recent investigation and taking cognizance of both living and extinct forms has long been a desideratum. Dr. Günther's 'Introduction to the Study of Fishes' (1880) did not at all represent the condition of ichthyology even at the time of its original publication, and the German translation (1886) was scarcely more than a reproduction, in another language, of the original work and retained almost all its numerous defects and errors. Those defects and errors were especially manifest in the treatment of the extinct forms. The increase in our knowledge of past types, too, has been very great within the last decade, owing to the labors of Mr. Smith Woodward, Prof. Cope and others. The desideratum indicated, to a certain limited extent, has been supplied so far as the 'fossil' fishes are concerned, in a recent work, by Dr. Dean, of New York, entitled 'Fishes, Living and Fossil.'* But it is not, as the author confesses, an elaborate introduction to ichthyology; its 'object is to enable the reader to obtain a convenient review of the most important forms of fishes and of their structural and developmental characters'

* Fishes, Living and Fossil. An outline of their forms and probable relationships. By Bashford Dean, Ph. D., Instructor in Biology, Columbia College, New York City.—New York: Macmillan & Co. 1895. (Columbia University Biological Series III.—8vo, xiv, 300 pp.)

(p. ix). A brief summary of the chapters will enable the student to judge of the extent and scope of the work.

In the first chapter, after the 'introductory, the form and movement of fishes, their classification, geological distribution, mode of evolution, [and] the survival of generalized forms' are considered (pp. 1–13).

In the second chapter, 'the evolution of structures characteristic of fishes, *e. g.* (1) gills, (2) skin defences, (3) fins, and (4) sense organs' are discussed (pp. 14–56).

In the third chapter, 'the Lampreys and their allies,' including 'the Ostracoderms and Palæospondylus,' are described (pp. 57-71).

In the fourth chapter (pp. 72-98), 'the Sharks,' in the fifth (pp. 99-115) 'the Chimæroids,' in the sixth (pp. 116-138) 'the Lung-fishes' or Dipnoans, and in the seventh (pp. 139-178) 'the Teleostomes (*i. e.*, Ganoids and Teleosts)' are briefly noticed.

In the eighth chapter (pp. 179-226) we are presented with sketches of 'the groups of fishes contrasted from the standpoint of embryology, their eggs and breeding habits, outlines of the development of Lamprey, Shark, Lung-fish, Ganoid and Teleost, [and] their larval development.'

Next are furnished unnumbered sections, giving 'derivation of names' (p. 227–230), 'bibliography' (p. 231–251), and 'explanatory tables' (V.–XIX.) continued (p. 252–283) from others given elsewhere (p. 8, 9, 98, 166) in the volume, which is capped with a full index (p. 285–300).

Fish is a word of diversiform meanings; it is the expression of a concrete notion and it is the symbol of an abstract concept; in the former sense it brings before the mind a vertebrate inhabitant of the water with a subfusiform body, and in the latter sense any inhabitant of the water as contrasted with one of the air or of the land; when it is used in such compounds as fish-form, fish-like, fish-shaped, fish-backed and fish-bellied, it is the typical fusiform fish that is meant; when shell-fish, star-fish and jelly-fish are named it is the abstract concept of inhabitants of the water that is imagined. In the latter sense it is a reminiscence of the time when men believed in the 'elements' of earth, water and air, and apportioned to each their inhabitants. Those inhabitants were designated by Plato as *ξηροτροφικὰ, ὑγροτροφικὰ*, and *ξηρονομικὰ*. In the cosmological dreams of elders of our 'Aryan' stock as well as the Semitic they were created specially for the elements in question; so imagined the Hebrew historians, and to like purpose did Ovid sing.

Dr. Dean well remarks that "it would be unreasonable to doubt that the fish form is adapted to the mechanical needs of its environment" (p. 6). Such adaptation is evident. Nature has evolved and developed the form; man has copied. The 'fish form,' in its perfection, is realized in the tunnies and other wanderers of the high seas. The forms whose movements are delineated (p. 2) after Marey are not of this class, but a stage or more removed from it. The typical fish can only describe simple curves; the shark with its sigmoid curve and the eel with its multiplex curve introduce other conditions. On the other hand, it is the typical and sub-typical fish forms that have been the subjects of Mr. Parson's memoir on 'the displacement and the area curves of fish'* and have furnished the four outlines copied by Dr. Dean (p. 5).

The typical fish form, as exemplified in the tunnies, is especially adapted for rapidity of locomotion, and all the fishes in which it is developed are preëminently coursers of the sea. But it is not alone by coursing that fishes obtain their daily food. To obtain that food, to secure safety and concealment, Nature has provided many devices

* Trans. Am. Soc. Mech. Engineers Vol. IX., pp. 679–695, with 7 pl. incl. 21 contours.

and innumerable deviations from the typical fish form are developed.

But, as Dr. Dean well observes, the fish form 'is a factor in the evolution of fishes which appears in [almost] every [large] group and subgroup. And it has ever stood in the way of classifying them satisfactorily according to their kinships' (p. 7). Still more aggressive as obstacles have been certain deviations from that form and especially the eel-like form. The anguilliform modification, resulting from elongation of the body and concomitant adjustments, such as union of the vertical fins, loss of the ventrals, and restriction of the branchial apertures, is apt to recur in various groups, and does occur in the plectospondylous 'eels' ('electrical eel,' etc.) and the symbranchoid to such a degree that it has been difficult even for ichthyologists to convince themselves that the likeness was deceptive as indication of affinity.

The progress of ichthyology has been in a ratio inverse to the influence on the mind of this ancient concept of the importance of adaptation of the organization for aquatic life. Many are still influenced by it. As a consequence all the branchiferous vertebrates are confounded in one class—the Fishes or Pisces. By most morphologists, however, that physiological group is subdivided into three or more classes. Three are admitted by Dr. Dean—the Leptocardians, the Marsipobranchs, and the true Fishes or Pisces. The last two are arranged in the following table (p. 8):

A CLASSIFICATION OF FISHES.

Type: CHORDATA (VERTEBRATES).
- Class: MARSIPOBRANCHII, Lampreys, *Palæospondylus*, Hag, Lamprey, *Ostracoderms*.
- Class: PISCES (TRUE FISHES).
  - I. Sub-class: ELASMOBRANCHII, Sharks and Rays.
    - Order: *Pleuropterpgii* (Dean), *Cladoselachids* (Dean).
    - " *Ichthyotomi* (Cope), *Pleuracanthids*.
    - " Selachii, Sharks and Rays.
  - II. Sub-class: HOLOCEPHALI, Chimæroids, Spook-fishes.
    - Order: Chimæroidei, *Squaloraiids*, *Myriacanthids*, Chimærids.
  - III. Sub-class: DIPNOI, Lung-fishes.
    - Order: Sirenoidei, *Dipterids*, *Phaneropleurids*, *Ctenodonts*, Lepidosirenids.
    - " ? Arthrodira, *Coccosteids*, *Mylostomids*.
  - IV. Sub-class: TELEOSTOMI, Ganoids and Bony Fishes (Teleosts).
    - Order: Crossopterygii, *Holoptychiids*, *Osteolepids*, *Onychodonts*, *Cœlacanthids*.
    - " Actinopterygii.
      - Sub-order: Chondrostei (Ganoids), *Palæoniscoids*, Sturgeons, Garpikes, Amioids.
      - " Teleocephali, recent Bony Fishes (Teleosts).

In this table Dr. Dean claims to have 'retained in the main the classification of Smith Woodward,' but he has adopted the most prominent features from Prof. Cope. It expresses, too, the ideas of most morphologists, but it is questionable whether Dr. Dean has gone far enough in the valuation of some groups. The reviewer would be inclined to admit four classes exclusive of the Leptocardians.

The 'Marsipobranchii' might be split into two classes—the Marsipobranchii (properly classed) and the Ostracophori or 'Ostracoderms' as Dr. Dean calls them. The latter are very imperfectly unknown, and only by Prof. Cope had they been previously associated in the same class as the Marsipobranchs. By Woodward they were ranked as a special subclass of true fishes. The evidence for any allocation is defective but for the present the group may be given class rank and retain the name Ostracophori. It was originally named Ostracodermi, but that name having been preoccupied (in 1872) by Gill for the Ostraciids, the new name was later given by Cope. But although first distinguished as a *subclass* under the name Ostracodermi, the differences between the representatives of that subclass and the Arthrodira had been to a considerable degree appreciated twenty years ago. The reviewer, in the article 'Ichthyology' in Johnson's Universal Cyclopædia (II., 1876) then gave the following arrangement of the extinct types:

'Super-order Dipnoi.

'Order Sirenoidei.

'(?) Order Placoganoidei* (extinct).

'Super-order (?) Aspidoganoidei (extinct).

'Order Cephalaspidoidea (extinct).'

The 'Elasmobranchs' of Dean and Chimæroids have been segregated in another class named Selachians or Elasmobranchs, and the two main groups have been regarded as sub-classes—Plagiostomes and Holocephals.

The Dipnoans and the Teleostomes are scarcely separable as classes, although often kept apart as such. The Dipnoans and Crossopterygians lose some of their salient characters, as we follow them back in time, and have evidently diverged from a common stock. For the united group the class name Pisces, or Teleostomi, can be used.

Such are the opinions of the reviewer, but perhaps Dr. Dean acted wisely in accepting the classification adopted. The succeeding pages teem with statements challenging attention and often perhaps dissent. In almost all cases, however, weighty evidence could be urged in favor of the views adopted. There are few cases where we feel disposed to bring forward objections, but a comparison of ideas on some mooted questions may be of interest and use.

The 'explanatory tables' towards the end of the volume give facts respecting the 'skeletons of fishes' (pp. 252, 253), 'relations of the jaws and branchial arches of fishes' (pp. 256, 257), 'the heart of fishes' (260), 'a comparison of gills, spiracle, gill-rakers and opercula' (260, 261), 'digestive tract' (263), 'swim-bladder' (264), 'genital system' (266), 'circulation of fishes' (269), 'excretory system and urinogenital ducts' (270, 271), 'abdominal pores' (271), 'the central nervous system of fishes' (274, 275), 'the sense organs' (276, 277), etc.

These tables give a large amount of useful and tolerably well digested information illustrated by apt figures and arranged under the main groups of fish-like vertebrates, as Cyclostomes, Sharks, Chimæroids, Lung-fishes, Ganoids and Teleosts. But useful as the tables are, the ordinary reader will be liable to fall often into error if he allows himself to trust them too implicitly. The exceptions to the general propositions are very numerous. Examples of such are 'tail heterocercal' (p. 252) in Selachians, or 'Sharks' and Rays, 'operculum, pre-, sub- and inter-opercula,' in Teleosts, etc. (261), 'many pyloric cæca' in Teleosts (263), and air bladder in Teleosts as in Sturgeon (264) but 'may be absent (Pleuronectids).' Hosts of the fishes respecting which the characters in question are predicated differ from the majority in wanting them. The remarkably aberrant Lyomeres, indeed, want all.

The anatomical portion is generally satisfactory, so far as it goes, and, although we may sometimes differ from the author as to homologies, he seldom falls into absolute error, as he does, for example, in calling the ventral fins of Ophidium 'barbels' (p. 47). He may be congratulated on having divested himself of 'his former view that the pineal foramen of *Dinichthys* contained a specialized optic capsule' (55) and of a corresponding view respecting the 'pineal foramen' of Siluroids. Apropos of the Siluroids, we feel disposed to dissent from Dr. Dean's statement respecting 'the most complete encasement of a fish's body dermal plates' as manifest in callichthyids. He thinks that the two lateral rows of plates are the result of 'extended fusions, a single

* Placoganoidei was an ordinal name for the Placodermi with dipnoan dentition.

dermal plate enclosing the upper or lower division of the muscle plate of either side' (p. 26). It is not evident what reason he has for such a belief, and why the extension of single plates is not more probable; equally improbable is the explanation of the size of the 'dermal plates of the Seahorse' resulting from 'fusions' (p. 26). As a rule, enlarged scales result from individual extension, and not general aggregation. The mode is suggested by the varieties of carp alluded to by Dr. Dean (p. 26).

A short chapter on 'the development of fishes' is given, and, on the whole, the subject is well brought up to date. Dr. Dean thinks that the data of embryology are 'very inconclusive' with reference to the successively increasing complication of structure, if at present in any way suggestive (p. 180). This is certainly the case if reference is had only to external features. 'Adaptive characters have entered so largely into the plan of the development of fishes that they obscure many of the features which might otherwise be made of value for comparison' (p. 180). Such being the case, we have no right to expect very much from superficial characters. It is the study of the anatomy, and especially of the developing bones, that will ultimately give useful hints. Indeed, only from a survey of the detailed comparative anatomy of the successive stages of the developing fishes have we a right to look for light on some questions of relationship and phylogeny. For instance, we should not expect much more guidance from mere externals of the various stages of '*Ceratodus*' than the illustrations actually give. Here it may be added that we are indebted to Dr. Dean for giving the results of such very recent work as that of Semon.

The nomenclature of Dr. Dean's work is mostly in accord with current American usage, so far as the American species at least are concerned, but sometimes that current in Europe is adapted, as *Bdellostoma* (61) instead of *Heptatrema*, *Cestracion* (85), for *Heterodontus*, *Læmargus* (91) for *Somniosus*, *Rhina* (91) for *Squatina*, '*Butrinus*' (258, 260, *Butirinus*) for *Albula*, etc. Sometimes there is a discrepancy resulting, perhaps, from the fact that the author may not have been fully aware that his names referred to the same form as *Squalus* (89) and *Acanthias* (216).

The numerous (344) figures are generally well selected and illustrate morphological and other data. Some, however, as most derived from Agassiz's and Pander's works and that of *Pleuracanthus* (90), might have been supplanted by later and better ones. A few, also, have been misplaced or misnamed, as 29, which really represents *Aetobatus* and not *Trygon*; 172 depicting *Bathyonus compressus*; 173 representing *Notacanthus sexspinis*; 174 representing *Paraliparis bathybius*, and 182 illustrating *Microgadus tomcodus* and not *Gadus morrhua.*

The most serious omission in the 'Fishes, living and fossil,' is of most of the living forms. Somewhere near 10,000 of those are Teleosts, and only about 350 living species belong to the other divisions. Nevertheless the systematic consideration of the Teleosts is condensed within 13 pages (165–178), and no idea is given of the range of variation and the diversity of that large group. The Cyprinoideans, the Characinoideans, the Cichloideans and the Percoideans, which constitute so large an element of fresh-water fishes, are not even mentioned as such. In the tables of 'classification' and 'distribution * * * in geological time' (pp. 8, 9) only six groups (Teleocephali, Clupeoids, Salmonids, Perches and Berycids, Siluroids, and 'Gadoids and other Teleosts') are named. Surely the student would reasonably expect to find more in a work entitled as it is.

Mention having been made of the 'Teleocephali,' it may be added that the group so called is by no means identical with the Teleosts, as stated (pp. 8, 165). The Teleocephali are an order of the sub-class of Teleosts restricted to such as have typically complete intermaxillary and maxillary bones and cranial in number exemplified or closely approximated by the Perch; it thus contrasts with the Nematognathi, the Apodes, and others.

The Nematognaths are considered by Dr. Dean, as by most old authors, to be 'closely akin to the Sturgeon' (p. 147), and, indeed, it is claimed that the Catfish 'is, perhaps, a direct descendant of some early type of Mesozoic Palæoniscoid' (p. 171). The same idea is also expressed in the exhibit of 'the phylogeny of the Teleostomes' (p. 166), where the 'Siluroid' branch is interposed between the 'Sturgeon' and 'Amia' and well separated from the 'Physostome.' It is likewise declared that 'their armouring is metameral and archaic, their sensory canals primitive in structure and arrangement' (p. 172). All this may be quite in accord with what has been believed by the most learned ichthyologists of old, but can be now known to be baseless. The Siluroids have no direct relations with the Sturgeons, the Coccosteids, or any of the extinct ganoid fishes, and are undoubtedly derivatives from the same stock as the Characinids and the Cyprinids. The armature, instead of being archaic, is of secondary development. The fishes themselves are more specialized and therefore more distant from the Ganoids than the Characinids and various other forms. The entire structure, including brain, vascular system, skeleton, weberian ossicles, air bladder, and morphological development generally, proves this and in turn is illustrated by this conception of their relationship. The similarity in appearance of Loricariids and Acipenserids, great as it is, is entirely superficial and illusive and should no longer be allowed to mislead. While referring to the Siluroids, it may be added that there is more than a 'single European species, *Silurus glanis*' (p. 171). There is another concerning which many data were published over 2200 years ago—the true Glanis of the Greeks and of Aristotle especially, the *Silurus*, or *Parasilurus Aristotelis*. Although this Greek fish has generally been supposed to be identical with 'the gigantic Wels of of the Danube,' it was, as declared by Agassiz 40 years ago, and demonstrated lately by Mr. Garman, a very different species.

Dr. Dean's misconceptions respecting the Siluroids are those of others. He declines to go to the extremes of some others, and very properly notes (p. 64) disbelief in the 'cirrhostomial origin [ascribed] to the mouth parts of a Teleostome (catfish).'

Some of the statements as to distribution and extent of groups may mislead. Of the Mormyrids, or genus *Mormyrus* as Dr. Dean calls the group, it is said, 'its species are restricted to the Nile' (p. 172), whereas species occur in all the rivers of tropical Africa. Of the *Anacanthini*, it is claimed 'that as many, perhaps, as one-quarter of the existing genera of fishes may be assigned to this type' (p. 174): in fact, the *Anacanthini* are comparatively few in number, especially if properly restricted. It is also said that 'of existing fishes about one-half are essentially percoid' (p. 174) and this also is a very much exaggerated statement.

The care which Dr. Dean has taken to bring his work up to date has already been adverted to in connection with Semon's researches on the embryology of *Neoceratodus*. Another example is found in the incorporation of the latest news about the earliest 'cyclostome.' References to recent memoirs (1890–92) on that interesting form are given (p. 238), and an illustration is reproduced (p. 65). We can scarcely agree with Dr. Dean, however, that it 'seems undoubtedly a lamprey;' apparently it represents not only a peculiar family (*Palæospondylidæ*), but a distinct order which may be called CYCLIÆ.

Only one other feature of Dr. Dean's work can be noticed. The volume is gracefully introduced and its scope indicated in the words of Aristotle—"Τῶν δ' ἐνύδρων ζώων τὸ τῶν ἰχθύων γένος ἓν ἀπὸ τῶν ἄλλων ἀφώρισται"* —and it is supplemented with a 'list of derivations of proper names.' There is, however, evidence of misconception of many etymologies, and corrected forms are here given of some of the names, leaving aside those that are substantially correct. Nevertheless it may be well to remark that the author need not have added adjective terminations for such words as 'fin(ned),' 'tail(ed),' 'tooth(ed),' 'bone(d),' 'spine(d),' and the like; they were correct without those endings and perfectly in harmony with such English words as Redfin, Hardtail, Fantail, Dogtooth (*Dentalium*), Greenbone, Porcupine and Spineback and such ancient Greek names as δασύπους, περκνόπτερος, ἵππουρος, μελάνουρος, and σινόδων. It is in this way that men naturally frame new names for such subjects.

The means for ascertaining or confirming the etymologies of many scientific names are, perhaps, not available for all who might desire to ascertain them, and they are often wrongly analyzed. To aid such inquirers is the aim of the following lines. If a scholarly man like Dr. Dean has found so many obstacles to correct information, less accomplished men must find the way still more difficult.

Acipenser is not from 'ἀκπήσιος, classic name of Sturgeon,' but is the old Latin name itself; both names were in use. According to Athenæus (VII., 44), "the accipesius, the same as the acipenser, or sturio, is but a small fish in comparison, and has a longer nose, and is more triangular than the galeos in his shape."

Alopias is not, of course, a transliteration of 'ἀλωπεκίας, classic name of the fox shark,' and the name has been replaced with *Alopecias* by many zoölogists (Müller and Henle, 1838,* Richardson, Günther, and various text-books). There is, however, no reason why the veriest purists should not accept *Alopias*. Rafinesque might have preferred to make the name directly from ἀλωπός (=ἀλώπηξ) and the terminal element ίας (in analogy with ἀλωπόχροος, fox-colored) and had a perfect right to do so.

Amia, it is too true, was misnamed after 'ἀμία, classic name of tunny (?),' but, although *a* tunny, the ἀμία was not *the* tunny. There can be no doubt as to what the ancients meant by ἀμία, and the old name was correctly referred nearly three centuries and a-half ago by Rondelet, while the correctness of the identification was confirmed by the most scholarly of later ichthyologists (Cuvier). Nevertheless, the fact appears to have been frequently forgotten of late and, therefore, reiteration with additional evidence will not be superfluous. The ἀμία was unquestionably the bonito of the books at least—the *Sarda sarda* of scientific nomenclature. Only this could have been the tunny-like form which had strong teeth which it could use successfully against sharks and in cutting the ropes of nets,† and which had a gall bladder stretched out upon the intestines and equal to them in length.‡

It was the bonito which, according to Archestratus.

"Towards the end of autumn, when the Pleiad

"Has hidden its light ———"

Was in season;

"——— then dress the amiæ

*The quotation from Aristotle occurs in the first paragraph of the ninth chapter of the second book of most editions of the Περὶ ζώων ἱστορία.

* Müller and Henle subsequently adopted *Alopias*.

† Aristotle, IX., xxv., 5.

‡ Aristotle, II., xi., 7.

"Whatever way you please——"

"For then you cannot spoil it if you wish."

It was the bonito which Epicharmus sang when he provided for the festive board

"—— large plump amiæ

"A noble pair i' the middle of the table:"

The etymology of ἀμία itself was given by Aristotle, according to Athenæus; the species was called *Amia* from its going in shoals with companions of the same kind.*

Amiurus is from ἀ, privative, and μείουρος, curtailed, and not from "ἀμία, Amia, οὐρά tail(ed)."

Ammocœtes is not derived from 'ἄμμος, sand, κοίτη (a bed),' which would mean sand bed, but from ἄμμος, sand, and κοῖτος [κοίτη does not have the double meaning '(a bed) abider.'] What might have been intended, was sand abider—ἄμμος and οἰκητής—which should have been rendered *ammœcetes*, and *ammocœtes* would then have been a simple case of metathesis. (The same lapsus, but in an aggravated form, is seen in the case of two well-known genera of birds—*Pediocœtes* and *Poocœtes*.) But unfortunately for the hypothesis Duméril sanctioned and adopted the name *Ammocœtus* and the etymology from ἄμμος and κοῖτος, 'séjour, *cubile*.'

Arthrodira is composed of ἄρθρον, joint and δειρή, neck (not 'δίς, double'), and is so called on account of the joint-like connections between the head and body armature.

Belonorhynchus is framed directly from βελόνη, a point or needle (*not* 'classic name of garfish'), and ῥύγχος snout. The ancient greek βελόνη was undoubtedly the pipefish, but the name in recent time has been perverted to the garfish.

Calamoichthys is from κάλαμος (rather than lat. 'calamus'), reed, and ἰχθύς, fish; *Calamichthys* would have been preferable because shorter, and accord with classic words, such as καλαμ-αύλης, etc.

Carassius is a latinized form of Karass, or Karausche, the German name of the *C. carassius;* not from 'χάραξ, classic name of (sea)fish.'

Cestracion is not from 'κέστρα,* classic name of (pavement-toothed) sea fish,' but from κέστρα, a broad-headed poleax (or 'malleus, malleator,' according to Klein). Klein applied the name to the hammer-headed sharks, and it was first misapplied by Cuvier to the genus previously named *Heterodontus* by de Blainville. The fish named κέστρα by the Greeks was better known as the *Sphyrœna*.

Chlamydoselachus was the original and proper form of the genus called *Chlamydoselache*. Σελάχη is the plural form and therefore improper; σέλαχος is the singular. Probably Dr. Dean was misled by Dr. Günther, who changed it to *Chlamydoselache*, and he was probably misled by Cuvier, who gave the name *Selăche* to the basking shark.

Cladoselache should have been called *Cladoselachus*.

Coccosteus is from κόκκος, berry (not 'κόκκος, rough like a berry') and ὀστέον, bone.

Cyclostomata is a compound of 'κύκλος,' circle, (not 'circular'), and the plural of 'στόμα, mouth.'

Dipnoi is not from 'δίπνοος, double breathing,' but δίπνοος, with two breathing apertures. The word occurs in Galen.

Erythrinus is not directly from 'ἐρυθρός, red-colored,' but from ἐρυθρῖνος, the old Greek name of the *Pagellus erythrinus*, and was misapplied to the American genus in sequence of a vicious habit which Linnæus

*παρὰ τὸ ἅμα ἰέναι ταῖς παραπλησίαις. Athenæus, VII., 6.

*κέστρα, in the old editions of Liddell and Scott's 'Greek-English Lexicon' (*e. g.*, 1864, p. 755), is defined '*a fish* held in esteem among the Greeks, doubtful whether *a pike* or a *conger*, Epich. p. 36, Ar. Nub. 339;' it is properly defined in later editions (*e. g.*, 1883).

and some others cultivated of using classical names for forms entirely unlike those for which the names were originally used.

Fierasfer, according to Cuvier, was the name current at Marseilles of the type species; therefore the 'derivation of Cuvier [was not] uncertain, perhaps, from proper name.'

Gadus is not 'the classic name of the cod,' which was practically unknown to the Greeks and Romans. The name does not occur in Aristotle, but in Athenæus (VII., 99), the words 'the ὄνος, which some call γάδος,' are quoted from Dorion. The name *Onos* seems to have been used in ancient Greece for the *Micromesistius poutassou* (*Gadus poutassou* of Risso), which now is called, in Greece, *Gaidouropsaron* (donkey-fish), or *Tsiplaki*. *Gadus* was first used as a generic name for the Gadids by Artedi, and subsequently limited, by exclusion of others and by definition, to the common cod and its congeners.

Ganoid is from γάνος, brightness, lustre, and εἶδος, appearance; not 'γάνος, enamelled.'

Hyperotreta (not Hyperotretia) is the better name of the order in question.

Ichthyotomi refers not 'to the distinctness of this group,' but to the alleged segmentation of the skull.

Lœmargus was not the 'classic name of a shark,' but derived from λαίμαργος, gluttonous. The name was applied by Müller and Henle to the genus previously called *Somniosus* on account of the character given by Scorseby to the type species.

Lepidosiren is from λεπίς, scale, and Siren, the name given by Linnæus to an eel-shaped amphibian, not a 'salamander.'

Ophidium is the Linnæan improvement of Ophidion of Pliny (XXXII., 35, 53); not ὀφίδιον, a snake.

Ostracoderm is simply the English form of ὀστρακόδερμος, hard skinned, from ὄστρακον (not ὀστράκιον), shell, and δέρμα, skin.

Protopterus is from πρῶτος, first or primitive (not 'ancient'), and πτερόν, fin.

Scomberomorus is from σκόμβρος, mackerel, and ὅμορος, neighbor, and not 'μόριον, part.'

Selachii is a new Latin equivalent of σελάχη (plural of σέλαχος), cartilaginous fishes generally,* and not 'σελάχη, shark.'

Teleocephali is from τέλεος, complete, and κεφαλή, head; not 'τέλεος, entirely, ὀστέον, bone, κεφαλή, head.' The cephalic bones are not reduced in number or proportions as in the Nematognaths and Apodals.

Teleostomi from τέλεος, complete, and στόμα, mouth; not 'τέλεος, entirely, ὀστέον, bone, στόμα, mouth.' Intermaxillaries and supramaxillaries are normally developed.

Other names whose etymologies require more or less emendation or explanation are *Ammocœtes*, *Anacanthini*, *Anguilla*, *Callichthys*, *Callorhynchus*, *Chimœra*, *Climatius*, *Crossopterygii*, *Dipterus*, *Elonichthys*, *Gyroptychius*, *Harriotta*, *Hemitripterus*, *Heptanchus*, *Hippocampus*, *Holoptychius*, *Ischyodus*, *Lamna*, *Mormyrus*, *Myliobatis*, *Mylostoma*, *Myriacanthus*, *Myxine*, *Palœoniscus*, *Parexus*, *Perca*, *Petromyzon*, *Phaneropleuron*, *Plectognathi*, *Pleuracanthus*, *Pogonias*, *Pristiophorus*, *Pristis*, *Protopterus*, *Pseudopleuronectes*, *Pterichthys*, *Raja*, *Rhabdolepis*, *Rhina*, *Rhinobatus*, *Scaphirhynchus*, *Scyllium*, *Silurus*, *Sirenoidei*, *Squalus*, *Squatina*, *Torpedo*, *Trachosteus* and *Trygon*. Interesting questions are involved in some of these names, but our already overcrowded space forbids lingering over any one of them.

The length to which this review has extended must be evidence of the importance of Dr. Dean's work. The suggestions here offered may be of use for another edition. That another may be called for, we may hope. For the work as it is and for the care and thought bestowed on it our thanks are due.

THEO. GILL.

*The Σελάχη are those which have been mentioned [βάτος, τρυγών, ῥίνη]; and the βοῦς, λάμια, αἰετός, νάρκη, βάτραχος, and all the γαλεώδη' (Aristotle, V., iv, 2.) In other words, the Selache include all the Sharks, all the Rays, and the acanthopterygian *Lophius*.

FOOD OF THE EUROPEAN ROOK (CORVUS FRUGILEGUS).

AN interesting paper upon the food of the Rook, by Dr. Hollrung, appears in the Seventh Annual Report of the Experiment Station at Halle,* and furnishes some points for comparison with the food of our allied species of American birds.

The following is a list of the principal contents of 131 stomachs of rooks killed in April, May and June:

48 larvæ of *Zabras gibbus.*	22 *Tanymecus.* (Weevils).
20 wire worms (*Elaterid larvæ*).	Snails.
253 grub worms.	Mice.
160 May beetles.	420 wheat grains.
1688 *Otiorynchus* (Weevils).	471 barley grains.
	190 oat grains.
	22 cherries.

From this Dr. Hollrung arrives at the following conclusions:

"1. The rooks examined have proved on the whole neither exclusively useful nor exclusively injurious. While 25 per cent. of the rooks' stomachs contained no vegetable matter, there were only two cases in 131 where no animal matter was found.

"2. Their food consisted for the most part (about 66 per cent.) of animal matter, such as mice, larvæ of the grain-eating Carabid (*Zabrus gibbus*), grub worms (*Melolontha vulgaris*), dung beetles (*Aphodius spec.*), and clover weevils (*Otiorynchus ligustici*). The vegetable food was made up of wheat, oats and barley and cherries.

"3. The harm done by the rooks on the one hand was perfectly balanced, and even considerably outweighed on the other hand by the useful services rendered.

"4. The rooks feed principally on slowly moving insects."

The common crow (*Corvus americanus*) represents, perhaps, in this country, as nearly as may be, the economic position occupied by the rook in Europe, and a few points of comparison in their food may not be without interest. The writer has examined about 900 stomachs of the American crow, taken at all times of the year and representing a considerable portion of the United States. Unfortunately Dr. Hollrung's rooks were all taken in the months of April, May and June, and within a restricted area of country, so that the stomachs probably show a larger percentage of animal food than the average for the whole year. The food of the crow for the same three months contains about the same proportion of animal and vegetable matter.

In the first four items of the above list the crow and the rook present a great similarity of taste, the *Lachnosterna* of this country replacing the *Melolontha* of Europe. It is in the next two items, the weevils, that the rook shines resplendent. An average of over thirteen specimens of those small but very harmful beetles in each of the 131 stomachs is certainly a splendid showing. The only American bird whose stomach the present writer has examined that can approach this record is the red-winged blackbird (*Agelaius phoeniceus*), which shows a very decided taste for the snout beetle.

While many of these beetles were eaten by the crow, they did not constitute so constant and important an item as in the case of the rook. The crow eats a considerable number of Carabid beetles, most of which are of the more predaceous species, while those eaten by the rook are for the chief part the larvæ of *Zabrus gibbus*, a very destructive grain-eating species. Grasshoppers, which are extensively taken by the crow, are conspicuously absent from the food of the rook.

In the varieties of vertebrate food the rook is far behind the crow. Only seven-

*Siebenter Jahresbericht ueber die Thätigkeit der Versuchs-station für Pflanzen schutz zu Halle a. S. 1895, Dr. M. Hollrung.

teen mice were found in the 131 stomachs, and in no case did any stomach contain the remains of more than one. The crow, on the other hand, not only preys upon mice and other small mammals, but even captures young rabbits and eats many snakes, young turtles, salamanders, frogs, toads and fish. The crow also eats many crayfish and other smaller crustaceans which do not appear in the rook's bill of fare.

In the matter of vegetable food the rook does not seem to indulge in any great variety in April, May and June, but probably the other months would show many additions to the list. The crow eats about every kind of grain that the country produces, besides fruit and acorns or other mast. The crow appears to be far more omniverous than the rook ; in fact, it seems doubtful if there is anything eatable that a crow will not eat, while, as far as shown, the rook seems quite exclusive.

In the comparison of these two birds the evidence appears to be in favor of the rook, although the economic difference is not great.

The proportion of harmful insects is somewhat greater with the rook, and its vegetable food does not include so many items of useful grains as with the crow. It is not possible, however, to come to any very definite conclusion until more stomachs of the rook shall have been examined, covering the other months of the year.

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AN INVESTIGATION WITH RÖNTGEN RAYS, ON GERMINATING PLANTS.

THE marked attention which the Röntgen or X-rays are receiving from investigators of this and other countries, and the popular excitement felt in the investigations, render all papers on this subject of particular interest.

The first record of experiments with these rays in their effect on plants known to the writer is a recent article by Alfred Schober presented to the German Botanical Society.* Schober was led to the investigation by the similarity between X-rays and ultra violet light, which was pointed out by Röntgen in his first paper. The subject appeared particularly worthy of investigation, as Sachs had shown that heliotropic curving is incited in plants by blue, violet and invisible ultra violet rays in about an equal degree with full white light; while the red, yellow and green parts of the spectrum are apparently inactive.

Rothert, in his very extensive work on heliotropism, found the cotyledo† of germinating oat plants to be particularly sensitive to the action of light, and these were thus selected for the experiment. Vigorous plants germinated in full light, with cotyledos from 1 to 2 centimeters long, were selected and set in damp sand in a dark box, the walls of which were about 1 centimeter thick and blackened on both sides. A Hittorf's tube was placed at one end of this box at the height of the seedlings and about one centimeter distant from the box. The seedlings were arranged at one end of the box so that they were about 2 centimeters distant from the tube. The inductor had a spark length of about 12 centimeters, and was kept at its highest capacity during the experiment. A photograph of a hand could have been taken under the same conditions at a distance of 30 centimeters in five minutes.

The plants were first exposed to the action of the rays for 30 minutes, after which an examination showed that no ap-

* Schober, Alfred, 'Ein Versuch mit Röntgenschen Strahlen auf Keimpflanzen.' Berichte d. Deut. Bot. Gesellsch. Bd. 14, Heft 3 (April, 1896), p. 108.

† *Cotyledo* is a term introduced by Rothert (Cohns' Beiträge zur Biol. der Pflanzen, Bd. 7, p. 25) to designate the leaf-like organ of the form of an almost cylindrical closed sheath which appears first after the roots in the germination of grass seeds.

parent effect had been produced. The box was then closed and the exposure continued for another half hour. A careful examination at the end of this time led to the conclusion that no visible effect had been produced. It was found impracticable to continue the experiment longer, as the tube in this time had become excessively heated.

After the experiment was concluded the plants used were proved to be normally sensitive, as an exposure of one hour to diffused daylight, passed through a small horizontal slit, resulted in a noticeable curvature which in four hours had reached 60° from the vertical.

As the inductor was excited to its greatest capacity during the experiment, the plant being placed in as close proximity to the light as possible—and as after the experiment the plants were found to be normally sensitive, showing noticeable curvature on an equal exposure to diffuse white light—the author concludes that the new rays appear to differ from light in that they do not stimulate heliotropic curvature.

This contribution to our understanding of the action of the X-rays on plants is very interesting, but it is not thoroughly satisfactory. While light induces a noticeable curvature on certain plants in one hour, the X-rays may not be so active. Until it is possible to expose the plant to the action of the X-rays for a longer time we are not justified in concluding that they have no power to induce heliotropic curvature.

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CURRENT NOTES ON PHYSIOGRAPHY.

GREAT VALLEY OF CALIFORNIA.

F. L. RANSOME discusses the heavy cover of fluviatile sediments, at least 2000 or 3000 feet thick, that form the floor of the Great Valley of California, in their bearing on the theory of isostacy (Bull. Dept. Geol., Univ. Cala., i, 1896, 371). Although chiefly concerned with geological problems, the essay gives a good general description of this typical fluviatile plain, dividing it into three sections, two of which are drained by the Sacramento and San Joaquin rivers, while the third sheds its waters into Tulare lake, of intermittent overflow. The great flat fans built forward by the larger streams from the Sierra are recognized as controlling the unsymmetrical position of the main rivers, The Sacramento and Feather rivers are said to 'pursue a winding course on low ridges;' this unsatisfactory and exaggerative term, 'low ridges,' being quoted from the Marysville folio, U. S. Geol. Atlas, to name the very faintly convex flood plains built by the rivers themselves. The smaller streams from the mountains "seldom reach the Sacramento directly, but are lost in the intricate plexus of sloughs which meander through the tule (reed) lands bordering the main river." A similar study of the Po in its relation to the Alps and Apennines would probably bring out many resemblances between these great fluviatile depositories of mountain waste.

NORWEGIAN COAST PLAIN.

AN instructive account, by Richter, of his studies last summer concerns the Norwegian coast plain (Globus, lxix., 1896, 313), on which Reusch has already given a brief report (Norg. geol. Undersög., 1894, with map; Chicago Journ. Geol., ii., 1894, 347). The coast plain, not to be confused with ordinary coastal plains of uplifted marine sediments, is wave cut in solid rock with little regard to structure, and is terminated landward by an abrupt ascent to the highlands. The visible breadth of the plain varies greatly, depending first on its original exposure to the waves, and hence having greater expansion on the ocean front and weakening to a mere strandline or disappearing entirely in the fiords; second, on its present attitude with respect to sea level, some broader parts rising 100 meters, others being entirely submerged. The open valleys of the interior, which are abruptly cut by the steep fiord walls, are referred to the same epoch and base-level as the coast plain. The plain was was made in preglacial time, and its uplifted surface is now much dissected. Richter emphasizes what Reusch said as to the important control exerted by the plain on the distribution of population and adds: "I regard this Norwegian coast plain as the greatest known example of well-proved marine erosion; perhaps the only one of so great dimensions in the world." The account is illustrated by four good views.

EQUATORIAL COUNTER CURRENTS.

A LARGE atlas issued last year by the Dutch Meteorological Institute at Utrecht, entitled 'De Guinea en Equatoriaal Stroomen,' clearly exhibits the periodic expansion of the Atlantic counter current in the northern summer; but unfortunately the area charted does not reach west far enough to take in the head of the current. From January to March, when the monsoon-like extension of the southeast trade across the equator as a south or southwest wind is practically wanting, the counter current is weak, irregular, and of small area. From July to September, when the southwest monsoon extends to 10° N. Lat. in mid-ocean, and even further north near the African coast, the counter current becomes definitely established between 4° and 9° or 11° N. Lat., with normal westward currents on either side. The strong temperature gradient on the northern border of the counter current near the African coast shows that it is not fed there by the North Atlantic eddy, as is represented on certain charts.

The January and July current charts in the atlas of the Pacific ocean lately issued by the Deutsche Seewarte (following similar atlases of the Atlantic and Indian oceans, with their sailing hand-books already published) gives additional confirmation of the control of equatorial counter currents by the monsoon-like extension of a trade wind across the equator into the summer hemisphere; first, by showing a great increase in the breadth of the counter current north of the equator in the chart for July, this being the only counter current ordinarily shown in the Pacific; second, by exhibiting in the chart for January a distinct counter current south of the equator in the western part of the ocean, about the Solomon islands, where alone in the Pacific the northeast trades cross the line into the southern hemisphere and blow for a time as north or northwest winds.

PLANETARY AND TERRESTRIAL CURRENTS.

THE current charts above referred to confirm the association of the general oceanic surface eddies with the change from day to night, the belt-like arrangement of the zones, the general circulation of the atmosphere, and the systematic deflections of the annual isotherms, as correlated features of a rotating, sun-lit, ocean- and air-bearing planet. Further, they confirm the association of faster currents (in temperate latitudes at least) in the winter hemisphere as well as of equatorial counter currents in the summer hemisphere, with the seasons and the migration of the isotherms, as well as marked characteristics of our own tilted-axis planet. Finally, they confirm the association of the irregular development of oceanic eddies and counter currents with the irregular outlines of the continents and oceans, and the various exaggerated deflections of the isotherms, as individual, non-geometrical features of the irregularly wrinkled earth. All this suggests a natural order of classification and presentation of these varied but related facts. It is the individual peculiarities of the lands and waters that produce a broader counter current north than south of the equator in the Indian ocean, that limit the south counter of the Pacific to the western part of that ocean, and that exclude a south counter current entirely from the Atlantic.

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CURRENT NOTES ON METEOROLOGY.

THE CLIMATOLOGY OF MARYLAND.

A SECOND edition of the Climatology of Maryland, originally published in 1894, has been issued as the *Second Biennial Report of the Maryland State Weather Service.* The data used in this compilation are the observations of the years 1892 to 1895, inclusive, and five charts accompany the report, showing the mean seasonal and mean annual precipitation and temperature. The Maryland Weather Service, organized in 1891, under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College and the U. S. Weather Bureau—a very happy combination of elements— deserves great credit for the work it is doing for meteorology in the United States.

METEOROLOGICAL OBSERVATIONS IN SCHOOLS.

THE Connecticut State Board of Education has issued a pamphlet on *Meteorological Observations in Schools* (Conn. School Doc. No. 10, 1896), which is intended to serve as an outline for the use of teachers who wish to give their scholars some practice in taking systematic meteorological observations of the simplest character. The time has come when some beginning in the teaching of meteorology in our schools should be made, and in order that such instruction may be systematic, and may serve as a basis for more advanced work in the later school years, an outline such as the present one is necessary. Teachers who are giving any attention to meteorology will find the pamphlet useful.

OTHER NOTEWORTHY PUBLICATIONS.

THE following recent publications are worthy of note:

H. C. RUSSELL: *A Map Showing the Average Monthly Rainfall in New South Wales.* (Read before the Royal Society of New South Wales, November 7, 1894.) The map shows, for each square degree of the Colony, the mean rainfall for every month.

SÜRING UND BERSON: *Die XV. Fahrt des Ballons 'Phönix' am 1 July, 1894.* (Zeitschr. f. Luftschiffahrt, February–March, 1896, 29–53.) An account of a balloon ascent to an altitude of 17,226 feet. Full meteorological observations were taken.

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SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

THE Saxon Academy has recently published a paper by Dr. Bruno Peter, containing the results of his observations with the new Repsold heliometer of the Leipzig observatory. The paper contains an extensive investigation of the instrument and a determination of the parallaxes of three stars whose parallaxes had not previously been measured. The most interesting thing brought out in the investigation of the instrument is an experimental verification of the possibility of eliminating entirely the effects of a varying focal adjustment of the eye-piece by the use of certain peculiarly shaped diaphragms in front of the object glass. That this is possible had been previously suggested from theoretical considerations by Dr. Abbe, of Jena. The only point in which Dr. Peter's method of observation differs materially from that usually employed is in the determination of the error of runs separately for each observation, instead of employing a constant value for the night.

The parallax observations have been effected very nearly according to the program used by Gill. The results obtained are as follows:

	Parallax.	
Bradley 3077,	+0″.13	±0″.012
Arg.-Oeltz. 10603,	+0″.17	±0″.013
31 Aquilæ,	+0″.06	±0″.015

It is to be regretted that Dr. Peter has not yet published the results of his observations of other stars. One would have supposed that the first publication of observations made with a new instrument would include the results obtained for stars observed elsewhere. Thus a comparison with the work of other observers would have furnished a certain check upon Dr. Peter's own work. The stars whose parallaxes have been observed by Dr. Peter, but still remain unpublished, are:

Eta Cassiopeiæ,	Theta Ursae Majoris.
Mu Cassiopeiæ,	Beta Coma Berenicis.
Lal. 15290,	Lal. 18115.

THE *Astronomical Journal* of June 4th contains a determination, by Mr. Eric Doolittle, of the secular perturbations of Mercury by the Earth. The computations were made according to the method of Gauss. There is also an orbit of Gamma Coronae Borealis by Dr. See. Prof. Comstock calls attention to the fact that his observations for the determination of the constant of aberration by Loewy's method show evidence of the existence of systematic error depending on magnitude in the observation of the right ascensions of the fundamental stars with the meridian circle. H. J.

HONEY ANTS.

AN interesting paper by Mr. W. W. Froggatt, of the Australian Museum, on Australian honey ants, has just been reprinted from the 'Report of the Horn Expedition to Central Australia; Part II., Zoölogy.'

Camponotus inflatus, Lubbock, has long been known (since 1880) to possess an inflated form of worker which the other ants in the colony use as store houses for the preservation of saccharine substance, just as is the case with the honey ants of Mexico, Colorado and Sarawak. The present paper describes two new species, *Camponotus cowlei* and *C. midas*, both congeneric with Lubbock's species and both possessing the honey-storing habit, though in less marked degree than *C. inflatus*. In fact, *C. cowlei* seems to be, to a certain extent, a transition form, or a form in which the differentiation into the honey-bearing workers has not proceeded to its fullest extent. Even in *C. inflatus* there is little or no structural difference between the honey-bearing workers and the ordinary worker, but the honey bearers are quite incapable of movement and must be fed by the ordinary workers. With *C. cowlei*, however, the honey bearers, although considerably swollen, seem to be able to move about slowly. It is possible that the only colony observed was a young colony and that the 'rotund' had not reached its full individual development. There is no hint by the writer that with the Camponotus honey ants there is any tendency towards the change to honey bearers on the part of certain of the workers by reason of any peculiar structure or form of intestine or abdominal walls, as has been suggested by Dr. McCook in the case of our Colorado Myrmecocystus. The development of this extraordinary habit in certain species which are perfectly congeneric with many other species in other parts of the world in which there is no tendency in this direction is not the least interesting phenomenon connected with this extraordinary subject. L. O. H.

SCIENTIFIC CONTRIBUTIONS FROM THE MISSOURI BOTANICAL GARDEN.

*The American Walnuts and Hickories.** The present paper, which in the main accepts the specific limitations and nomenclature of Prof. Sargent's Silva of North America, is devoted mainly to an analysis of the characters by which the hickories and walnuts and butternut may be distinguished in their winter condition, it being claimed that the characters afforded during that season are even more satisfactory than those obtainable during the earlier period of growth. The twig and bud characters and the characters of a great variety of fruits are illustrated in detail, and reproductions are given, direct from photographs, of the bark of a number of the species. Several interesting hybrids are also discussed in detail.

The Agaves of the United States.† About

* Juglandaceæ of the United States. By William Trelease. Issued May 26, 1896. Reprinted from the Seventh Annual Report of the Missouri Botanical Garden. Pages 25–46, plates 1-24.

† The Agaves of the United States. By A. Isabel Mulford. Issued May 26, 1896. Reprinted from the Seventh Annual Report of the Missouri Botanical Garden. Pages 47–100, plates 26-63.

twenty years ago the late Dr. Engelmann made an attempt to classify and describe the species of Agave of the United States, the genus to which the Century plant and Maguay belong. Since that time much information and material have been accumulating, and in St. Louis, where Engelmann's notes and specimens are preserved, the study of this difficult genus has been again undertaken. Miss Mulford, whose work was the basis of a thesis for which she obtained the degree of Doctor of Philosophy from Washington University in 1895, has brought together in a carefully arranged synoptical form the technical descriptions of all of those species which are now recognized as occurring within the limits of the United States, and has added much information of a popular character concerning their economic uses. The paper is supplemented by reproductions of habit photographs and a large series of accurate detail illustrations from drawings by Miss Johnson.

*Two Interesting and Rare Water Plants.** Mr. Thompson gives an exhaustive account of the structure, and, so far as known, the biology, of two very rare duckweeds, Wolffia gladiata, var. Floridana, and W. lingulata, the former heretofore known only from Florida, but collected last year in the swamps of southern Missouri, where it occurs associated with other peculiarly Floridan plants, such as Leitneria; the other heretofore known only from the Mexican tablelands, but detected by Mr. Thompson in Kern County, California, last year.

* The Ligulate Wolffias of the United States. By Charles Henry Thompson. Issued May 26, 1896. Reprinted from the Seventh Annual Report of the Missouri Botanical Garden. Pages 101–111, plates 64–66.

GENERAL.

THE associated press sends news of a terrible earthquake disaster in the Island of Yesso, Japan. It is stated that there were as many as 150 shocks lasting in all about 20 hours. The earthquake and the accompaning tidal wave caused great loss of life and property.

THE library building presented to the town of Branford, Conn., by Mr. Timothy Blackstone at a cost of about $300,000 was dedicated on June 17th.

THE *Scientific American* states that the Egyptian government has determined to commence a geological survey. The work will be begun this year, and will take about three years for its completion. The estimated cost is $125,000. Capt. H. G. Lyons, R. E., who is at present engaged under the Public Works Department of the Egyptian government in superintending the excavation of the ruined temples of Philæ, will have charge of the survey.

FIFTY photographs from the recent exhibition at the Cosmos Club, Washington, have been selected for purchase by the U. S. National Museum. There will be held next year at Washington a second exhibition of art photography under the name of 'The National Photographic Salon of 1897.'

THE Romanes Lecture for 1896 was delivered by the Right Rev. the Lord Bishop of Peterborough, on June 17, his subject being: 'English National Character.'

WE learn from *Nature* that Sir George Stokes and Dr. Carl L. Griesbach, Director of the Geological Survey of India, have been elected honorary members of the Austrian Academy of Sciences. Dr. Roux has been elected Associate of the Academy of Medicine in the room of the late M. Pasteur.

PROF. F. A. MARCH, of Lafayette College, the eminent philologist, will receive during the present month the degree of Lit. D. from Cambridge University, and the degree of D. C. L. from Oxford University.

MISS L. BRUCE has given to the University of Heidelberg a photographic telescope said to be even larger than the one she gave to Harvard University.

THE Mississippi Valley Medical Association will meet at St. Paul, Minn., under the presidency of Dr. H. O. Walker, from October 20th to 23d.

AT a meeting of the board of managers of the New York Botanical Garden on June 17th the Committee on Plans reported favorable progress, and the report of the Committee on Annual Members, Fellows and Patrons stated that a large number of annual members had been recently added to the rolls, and that President

Seth Low and F. F. Thompson had qualified as fellows by the payment of $1,000 each. The Director-in-Chief, Dr. Britton, was authorized to secure the assistance of engineers, landscape architects and gardeners in preparing the plans for the development of the Bronx Park site. Several gifts were announced, including the herbarium of the late Harry Edwards, from Mrs. Esther Herrman.

Garden and Forest states that a preliminary meeting of citizens of New York interested in tree-planting in the residence portions of the city was held May 22d, and it was proposed to regularly organize the association and elect officers on Thursday, June 25th, at 3:30 p. m., in the rooms of the Wool Club. Mayor Strong has consented to the use of his name for President, and many well-know citizens have signified their intention to become members. The annual dues of the society will not exceed $5.00, and the receipts will be used to publish pamphlets and in disseminating information to the public on the best methods of planting shade trees on streets, the best sorts for this purpose, etc. Application for membership may be made to Cornelius B. Mitchell, 64 and 66 White street, New York. We also learn from the same journal that seven hundred and seventy-five members have already enrolled themselves in the Audubon Society, established a few weeks ago in Boston. The object of the Society is to preserve our native birds by discouraging the use of their feathers in personal decoration. Among the Vice-Presidents of the Society are the senior Senator of Massachusetts, the President of the Massachusetts Historical Society, the President of the Massachusetts Society for Promoting Agriculture, and many other well-known citizens and a number of women distinguished for their artistic and social attainments. Any one can become a member of the Society by agreeing not to purchase or wear the feathers of wild birds and paying $1.00. The Secretary, to whom all communications should be addressed, is Miss Harriet E. Richards, Boston Society of Natural History, Boston. There are no annual dues.

A NEW monthly journal, devoted especially to the study of children, edited by Prof. Earl Barnes, will hereafter be published from Stanford University.

AN X-ray studio has been opened by Mr. M. F. Martin, at 110 East 26th street, New York.

IN a paper first presented before the Michigan Academy of Science, and now printed in *The Inlander*, Mr. Harlan I. Smith urges the importance of making a systematic archæological survey of the State of Michigan, with the University as headquarters. It would be a great advantage to have recorded on a map the position of pre-historic remains, in order that permission might be obtained to make scientific excavations when opportunity offered, and in order that preference might be given to those remains least likely to remain intact.

THE degree of D. C. L. will be conferred by Oxford University on Sir Archibald Geikie, K. C. B., F. R. S., Director-General of the Geological Survey of the United Kingdom.

MISS HELEN KELLAR, who, deaf and blind, has displayed unusual ability, will be placed, next autumn, in the Gilman training school, with a view to preparation for Radcliffe College. The education and mental attainments of Helen Kellar are even more interesting than in the case of Laura Bridgeman. Those who are interested will find an account by her able teacher, Miss Sullivan, in a publication from the Volta Bureau, 1892, and in an article by Prof. Jastrow in *The Psychological Review* for 1894.

IN a recent number of SCIENCE we called attention to the international membership of the German Chemical Society. A striking contrast is found in the recently published list of members of the Chemical Society (London). Out of 2,067 members, over eighty-five per cent. are residents of the United Kingdom, and more than half the remainder of British colonies. Of the 140 foreign members 92 are American, 16 German, 7 Japanese, and the remaining 25 from eighteen different countries. Considering the Journal of the Chemical Society and its invaluable abstracts, it is rather surprising that the Society should have so few members outside of the British Empire.

THE first part of a very important work by Drs. D. S. Jordan and B. W. Evermann, entitled 'The Fishes of North and Middle America,' has been for some time in type and will be published shortly by the Smithsonian Institution. This part will be a volume of over 1,250 pages and will embrace descriptions of 1,239 species under 522 genera. According to the preface, "the classification and sequence of groups * * * adopted is essentially that of Dr. Theodore Gill," and the part in press covers the families from Branchiostomidæ to Priacanthidæ, including 148 families. The second part, which may be even larger than the first, it is expected, will appear early next winter.

According to the *British Medical Journal* a society has recently been formed entitled 'L'Alliance Nationale pour le Relévement de la Population Francaise par l'Egalité des Familles devant les Impôts.' M. Bertillon, the Director of the city of Paris statistics, is the founder of the Society. A committee has been formed composed of M. Bertillon; Prof. Richet, of the Paris Medical Faculty; Dr. Javal, member of the Academy of Medicine and of the Chamber of Deputies; M. Honnorat and M. Cheysson. The first meeting of the Society was held on May 16th, and was attended by about a hundred people.

The daily papers contain several communications regarding reputed anticipations of the X-rays sufficiently curious to deserve repetition. Dr. G. A. Brown is stated, by the *Grand Rapids Herald*, to have in his possession a magazine entitled the *Mechanics' Mirror*, which, in 1846, is said to contain this announcement: "The following communication was made to the Academie Royale des Sciences de Paris at its last meeting by a Greek physiologist, A. M. Esseltja, who asserts that by the assistance of electric light he has been enabled to see through the human body, and thus to detect the existence of deep-seated disease. He has followed the operations of digestion and of circulation. He has seen the nerves in motion. M. Esseltja has imposed the name of 'Anthroposcope' on his extraordinary discovery (?). According to the *Scientific American*, Mr. John P. Moss writes to the *Daily News* under the heading 'Nothing New under the Sun,' quoting the following paragraph from Dr. Priestley's Electricity, 1769. It describes an experiment made by Mr. Hawkesbee in 1709. "He (Mr. Hawkesbee) lined more than the half of the inside of a glass globe with sealing wax, and having exhausted the globe, he put it in motion; when, applying his hand to excite it, he saw the shape and figure of all the parts of his hand distinctly and perfectly on the concave superficies of the wax within. It was as if there had only been pure glass and no wax interposed between his eye and his hand." Baron Reichenbach claimed that his light from the poles of a magnet would pass through the fingers.

Mr. G. C. Bourne has contributed to *Science Progress* two interesting articles on the present position of the cell theory. After reviewing recent work and theories he concludes that life is possible only when two (or more) substances of complex chemical constitution are brought together, and that when these two (or more) substances are brought together we have before us a cell. The cell, therefore, is the vital unit *κατ' ἐξοχήν*. The component parts of the cell are not vital units, for by themselves they are incapable of life; they are the auxiliaries, the indispensable auxiliaries of life, but they are not themselves living. If this be true it is entirely inconsistent with the whole group of theories based upon hypothetical biophors, gemmules, plasomes, physiological units, plastidules et hoc genus omne. The cell theory is the only theory which our knowledge of structure and of life processes permits us to adopt, at least if we confine ourselves to that part of it which is essential, namely, that there is one general principle for the formation of all tissues, animal and vegetable, and that principle is the formation of cells. Cells are the ultimate vital units, though they are not the ultimate structural units; they are the 'Lebenstrager' or biophors, and there are no living individuals lower than cells.

President Jordan, in his *Fishes of Sinaloa*, has recently published the first bulletin of The Hopkins' Biological Laboratory, the recently founded dependence of the Leland Stanford, Jr., University, and it will be received with a great deal of interest by the students of fishes generally. The paper, continuing the well-known work in this region of Dr. Gilbert, consists of a systematic review of the fishes of the eastern shore of the Californian Gulf, in the Mexican province of Sinaloa. Twenty-nine new species are recorded, many of which are here figured, including a new Saw-fish and several new Sting-rays. The present work, however, can be regarded only as the result of a reconnaissance, although it is clearly of great value. Except in the case of *Chanos*, it deals with no osteological characters; and from the nature of the Hopkins expedition, one can hardly expect that any definite information could have been obtained as to the larval characters of these fishes, or as to the ranges of sexual variation.

ACCORDING to the London *Times*, the British Consul at Piræus mentions in his last report that a Pasteur Institute for the treatment of hydrophobia by inoculation has now been in existence in Athens for some time. During the first 16 months of its existence 201 cases were treated, of which 176 were from Greece, 21 from Egypt, and 4 from Asia Minor. There was only one death, and in this case the patient had delayed going for treatment until 15 days after being bitten. The whole credit of founding the institution belongs to Dr. Pampoukis, the director, who was sent to study under M. Pasteur in Paris in 1886, and who, on his return, started a microbiological institute at his own expense and conducted a series of valuable experiments for the government. He opened the Pasteur Institute in August, 1894, at his own expense; small allowances have since been made to him by the municipality and the government. It is practically impossible to overestimate the value of such an establishment in the Levant, and its existence ought to be widely known. Not only does the curse of masterless dogs exist in Greece, but even more so in the neighboring countries. A muzzling order does exist in Attica, but it is not enforced, and the strewing of poisoned meat in the streets of Athens and Piræus is apparently the only attempt made by the authorities to deal with an increasing amount of rabies. The lack of water and the prevailing disregard of all forms of animal suffering largely contribute to this result.

THE N. Y. *Evening Post* states that the agricultural extension work carried on by Cornell professors under the provisions of the Nixon fund i being yearly extended. Originally confined to the Chautauqua grape belt, it was last year extended to Genesee. This year Prof. Bailey has organized work in Oswego county, where experiments in strawberry culture are to be made, and in Onondaga and Oneida counties. The work in each county partakes of the prevailing local farm industry.

THE School of Applied Ethics, which for the past four years has held sessions at Plymouth, will omit the session this year.

UNIVERSITY AND EDUCATIONAL NEWS.

DR. B. I. WHEELER, of Cornell University, has been elected president of the University of Rochester.

PROF. GRAVES, of Tufts College, has been elected president of the University of Wyoming.

MRS. S. W. BOCOCK has given $5,000 to Yale University for the purchase of books in social science.

AT Cornell University an appropriation of $15,000 has been made for constructing a hydraulic laboratory for the College of Civil Engineering, and $30,000 has been appropriated for an addition to Lincoln Hall, for the accommodation of the College of Architecture.

THE present and past students of Radcliffe College and the Cambridge School are uniting to found a scholarship at Radcliffe College to be known as the Arthur Gilman Scholarship in recognition of the services of Mr. Gilman, who is about to resign his office of Regent.

AT Smith College Miss G. A. Smith has been appointed assistant in botany, Miss H. W. Bigelow, assistant in astronomy; Miss L. D. Wallace, assistant in zoölogy, and Miss E. S. Mason, instructor is chemistry.

DR. WESTERMAIER has been called to a professorship of botany in the University of Freiburg, Switzerland; Dr. Peltz to the chair of mathematics in the Technical High School at Prague, and Dr. Went to the professorship of botany in the University of Utrecht in the place of Prof. Rauwenhoff, who has retired.

AT the commencement exercises of Cornell University, President Schurman made an address on Liberal Culture and Professional Education, in the course of which he justified the recent action of the University in offering the B. A. degree in place of the degrees of Bachelor of Philosophy, Science and Law. He held that liberal culture does not come alone from the study of classics. "If it be said that the action of Cornell University destroys the conception of liberal culture, I reply that, far from destroying the conception, it enlarges and revivifies it and brings it into living relation with all the intellectual and æsthetic elements of our modern complex civilization. It is folly to suppose that some parts of human knowledge are liberalizing, and others neutral or negative; or that some institutions yield culture, and others merely science."

DISCUSSION AND CORRESPONDENCE.

THE APPLICATION OF SEX TERMS TO PLANTS.

TO THE EDITOR OF SCIENCE: If I do not mistake Prof. Bailey's meaning in his article 'On the untechnical terminology of the sex-relation in plants' (SCIENCE, N. S. III., 825), he advocates a use of the terms male and female in semi-popular language which he acknowledges to be in reality incorrect, since he accepts as true the present view of the morphology of the members involved. It should be remembered that this usage arose when the morphology of the stamen and pistil was not understood, and when the ovule in the pistil was really believed to be an egg within an ovary and the pollen grain in the anther, the sperm within a spermary. The question to be discussed is "Shall this usage be continued in 'common' language?"

It may be conceded at once that it is of no practical importance to a horticulturist (whose interests Prof. Bailey clearly has at heart) whether he is taught to apply sex terms to flowers and their members or not. Seed time and harvest will not fail because he does not know the plants he deals with. But suppose a student whom Prof. Bailey has inspired with a desire for more extended study goes to another teacher for a course in morphology. He has been taught to call a stamen a 'male organ.' He is given a staminate flower of a pine. He is permitted to call its members stamens, and in their 'maleness' his professor of horticulture has led him to believe. Very good. He is then given a shoot of Equisetum, bearing what the Manual is pleased to call a 'fertile spike.' He discovers its close resemblance to the former specimen, and perhaps thinks to call it a 'male flower' and its members 'male organs.' But as he studies the life history and seeks to discover the 'function of paternity,' in some unaccountable way the maleness vanishes, and instead he finds an organ exhibiting at the same time both 'maleness' and 'femaleness'—discharging at the same moment 'the function of paternity' and 'the function of maternity'—quite as truly, at least, as the stamens 'discharge the paternal relation.'

Will Prof. Bailey hold that the stamen-like sporophylls of Equisetum should, therefore, 'in the broad sense of common language,' be called hemaphrodite organs? If so, what will he say to the sporophyll of Botrychium or Onoclea, whose spores produce a bisexual plant? By what sex term will he designate untechnically the office of such sporophylls? I do not take him here beyond the plants with which the florist deals and about which he may rightly demand instruction. Surely, in this day, Prof. Bailey would not desire to perpetuate, even among amateurs, the fiction that between the ferns and the flowering plants there is a great gulf fixed? Yet the loose use of language which he advocates would seem to require an affirmative answer. Into what hopeless confusion this would plunge the poor student, only he can imagine who has seen the difficulty with which one eradicates from his thought and language the misleading analogies which he has merely acquired accidentally. How much more difficulty would they give were they inculcated by a trusted teacher!

Although Prof. Bailey enunciates briefly in his introduction the doctrine of the alternation of the sexual and non-sexual phases in plants, he seems to have failed to grasp its significance when he writes: "Surely the prothallus is no more sexual than a stamen or a leaf." The essential character of the sexual phase is that it produces gametangia, *i. e.*, sexual organs, in which the sex cells are differentiated. The essential character of the non-sexual phase is that it produces sporangia, *i. e.*, non-sexual organs, in which spores are differentiated. All that morphologists ask of Prof. Bailey is that he use the same criterion with plants as with animals, applying, by a common grammatical figure, sex terms to the organs that produce sex cells, and to the plants that carry the sex organs. It is for this reason that it is proper to call a bull a male animal and a cow a female animal. But if the embryo produced by the union of their sex cells grew into an animal 1,000,000 times the size of the bull or the cow, and one of its giant cells formed within itself a bull and another within itself a cow, we should certainly not be justified in applying sex terms either to the monster or to any of its organs.

When Prof. Bailey asks to have the figurative use of the sex terms *extended so as to obscure the distinction between the sexual and non-sexual phases of the plant*, he asks us to return to a confusion from which botanical language has been happily delivered, and from which it is the duty of botanists to deliver 'common language.' This deliverance can be brought about simply by using untechnical terms already coined and by avoiding the use of sex terms for a purely vegetative organism. 'Staminate flowers' and 'pistillate flowers' are phrases quite as untechnical as 'male flowers' and 'female flowers,' and they have the advantage of avoiding the perpetuation of obsolete ideas.

Were the question merely one of morphological consistency it would be of comparatively little moment. But it is a question of clearness or confusion of ideas. If the mental eye, as it looks upon plants, be not single, the the whole mind will be full of darkness; and if the morphological light that is in the student be darkness, how great is that darkness! To advocate one set of ideas for common language and another for technical is to advocate a return to that chaos of which the professional botanist himself was scarcely conscious until the light of the doctrine of the alternation of generations broke forth. In its light it behooves us to order our use of language that applied botany will be helped toward a clearer view of plant life.

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SCIENTIFIC LITERATURE.

Antropometria Militare. By DR. RIDOLFO LIVI. Parte I. Text and Atlas. Roma. 190+419 pp; 23 plates.

The first part of Dr. Livi's great work on the anthropometry of Italy has recently been issued by the Director of the Italian Army Medical Journal. The work ranks easily among the most important contributions to anthropology. The fact that in past years Dr. Livi has contributed some of the most fundamental results of his extended and careful investigations to the Archivio per l'antropologia e la etnologia and presented others that are not less interesting to the Roman Anthropological Society and to the Eleventh International Medical Congress (Rome, 1894) has made the complete presentation of his data only the more eagerly expected. The present part contains the purely anthropological results of his investigations, while the second part will be taken up by hygienic and in a more general way sociological statistics.

The investigations are based on measurements and observations upon men born in the years 1859–63 and enlisted in the Italian army. The anthropometrical data that were collected are the following: Stature, circumference of chest, weight, length and breadth of head. Be sides these a number of descriptive features were observed: Color of eyes and hair, complexion, character of teeth, form of forehead, of nose, of mouth, chin and face. These data have been worked up in the following detailed tables:

For each military district (Mandamento):

1. The frequency of statures in groups of from 5 to 5 cm.

2. The frequency of the various colors of the hair and of the eyes and that of the pure blonde and of the pure dark type.

3. The average cephalic index and its distribution in groups from 5 to 5%.

For the larger districts (Circondario) the preceding data are summarized and the following are added:

1. The relation between stature and color of hair.

2. The relation between stature and color of the eyes.

3. The relation between color of hair and color of eyes.

4. The relation between stature and cephalic index.

5. The relation between the cephalic index and color of hair.

6. The distribution of the cephalic index for each per cent.

For the provinces the previous data are summarized and the following are given in addition:

1. The distribution of the circumference of the chest in groups of 5 cm.

2. The relation between stature and circumference of chest.

3. The distribution of statures for each cm.

4. The frequency of the principal descriptive characters, form of hair, complexion, nose, face and chin.

These results are presented in a most attractive manner, on an atlas which brings home some of the salient results of Dr. Livi's extensive work at a single glance.

It is not possible to enter into all the important results which the author by the judicious use of good statistical methods has reached. From a general point of view the most important is perhaps the final proof of the fallacy of the theories of Dr. Ammon in regard to the effect of natural selection upon the development of the type of civilized man. A number of years ago Tönnies pointed out the weakness of his arguments (Ztschr. für Psychol. u. Phys. der Sinnesorgane), but it remained to Dr. Livi to finally prove the real cause of the phenomena which Dr. Ammon had observed, namely, that the inhabitants of the towns of Baden are more dolichocephalic than those of the country. Dr. Livi has shown that everywhere the cephalic index of the town population is nearer the average than that of the country population. Consequently in a brachycephalic region, such as Baden, the people of the towns are more dolichocephalic, while in dolichocephalic regions the reverse is the case (p. 86 ff.). The satisfactory explanation of this fact is that the town population are more mixed than the country population is. The author has proved that the same facts may be observed in regard to the distribution of color of hair and eyes and of statures, and I think that in this observation he has given a very strong proof of the heredity of stature.

Among other points of biological interest I mention the detailed investigation of the influence of the altitude of habitat upon the various measurements. The clearest and best pronounced example of such an influence that the author has found is that upon the circumference of the chest which increases with increasing altitude. The stature decreases quite considerably in the mountainous districts. The color is lighter than in the plains. The two last phenomena the author is inclined to attribute to an earlier arrest of development due to more unfavorable social conditions, but he does not deny the possibility of other influences of altitude upon the development of the human body. The observation that among the primitive Americans the stature also decreases with altitude seems to me to indicate that social conditions alone do not sufficiently account for the phenomenon.

Of special interest are also the detailed investigations on the correlations of the various observations, for instance, of the proportions of the head and the color of the hair which show clearly that the dark people are the more dolichocephalic ones, and that tall people have more frequently wavy hair than short people.

Most of the relations of measurements or observations treated by Dr. Livi are based on stature, *i. e.*, the individuals are grouped according to stature and the correlated changes of the other measurements have been recorded. While the results thus obtained are of great value it would probably have been better to treat them as correlations, that is to investigate also the reverse relation. The undue weight which is thus given to stature as compared to all other measurements would have been obviated by this means. This mode of treatment would have been the more desirable, as stature is one of the measurements which depend to a considerable extent upon the influence of environment. Besides this the distribution of stature as recorded by Dr. Livi is, as he himself points out, not that of the total population, as all those individuals who are unfit for military service are not included in the records. Thus all of less than 154 cm. stature are excluded, and among the others who were rejected for other reasons the lower statures probably prevail. For this reason his average statures are all too high, and the distributions of statures appear more assymetrical than they would be if the total population were considered.

The remaining portion of the volume is taken up with a detailed discussion of the geographical distribution of the various anthropometric types. It is not possible to enter into this interesting subject at this place, and it may suffice to call attention to the important results that the author has reached. Historical events relating to the settling of certain portions of Italy are reflected with remarkable accuracy in the charts showing the distribution of types. I mention, for instance, the occurence of a tall dolichocephalic type near Lucca, and the peculiarities of the type inhabiting Carloforte as compared to the rest of the inhabitants of Sardinia.

This exhaustive work will always remain the basis of all studies on the anthropometry of the people of the Italian Peninsula.

FRANZ BOAS.

Electric Lighting, a Practical Exposition of the Art for the Use of Engineers, Students and Others interested in the Installation or Operation of Electrical Plants. Vol. I. *The Generating Plant.* By FRANCIS B. CROCKER, E.M., Ph. D., Professor of Electrical Engineering in Columbia University. 8vo. VIII. 444 pp. New York, D. Van Nostrand Company.

In the preface the author states his belief—and he is undoubtedly correct—"that electric lighting has reached a sufficiently perfected and established state to allow of its being treated in a fairly satisfactory and permanent manner."

According to the plan adopted by the author, the subjects treated in this volume are taken up in the following order: Two chapters are devoted to the introduction and historical matter; the third discusses units and measures, and the fourth treats of the classification and selection of electric lighting systems. The clear and candid statement of reasons which should influence the selection of a system makes the fourth chapter of great practical value.

It is evident, however, that Prof. Crocker advocates the use of the direct current where many engineers would prefer to use an alternating system; and while he very properly quotes the value of human life as one of the factors which should influence a decision, he seems to neglect the fact that good work and materials will render any current in commercial use practically safe, while want of care in wiring and poor insulation will, through the fire risks involved, make either system an indirect menace to human life, far more serious in its nature than the direct danger threatened by the employment of high voltage alternating currents.

Two chapters follow which consider location and buildings, and then the author proceeds to the consideration of sources of energy, prime motors, and the mechanical connections between engines and dynamos. The chapters devoted to these subjects fill two hundred pages, or nearly one half of the volume.

After these come two chapters in which the design and construction of electrical machines is briefly treated. There is no lumber in this part of the work, and the reader will miss the time-honored descriptions and illustrations which have been so prominent in electrical text-books for the last fifteen years.

The next chapter is one of the most valuable in the book; it is largely taken from a work by Prof. Crocker and Dr. S. S. Wheeler, and contains more direct and practical instruction as to the care and use of electrical machinery than can be found in the same number of pages elsewhere.

The author knows his subject and knows how to tell what he knows, a rare combination one is sometimes tempted to believe.

The remainder of the work, about sixty pages, is devoted to accumulators, switch-boards and apparatus, and electrical measuring instruments.

The distribution and utilization of electricity for the purpose of illumination are subjects reserved for a second volume.

A very valuable feature of the book is found in the abundant reference made to books and papers treating single topics more fully than the limits of this work will allow.

It is practically impossible to give in a treatise of moderate size more than a small part of the matter absolutely necessary for the use of the student when the subject treated is a branch of pure or applied science. And the author who neglects to avail himself of this simple method of enormously increasing the value of his book does grievous injustice to his subject, his readers and himself. No engineer can be a man of one book. The profession needs a broad and deep foundation. Outline treatises, schedules, abstracts from lecture courses and pocket manuals are valuable in their way, but they should be used only as guides to a systematic course of reading or as memoranda in which are collected the results of previous study.

No one probably knows the truth of these statements better than Prof. Crocker, and without doubt it is his recognition of the impossibility of making a complete presentation of his subject which has inclined him to supplement his text with so many valuable references. It is in this connection that the chief criticism upon this work is to be made. The sub-title, 'A Practical Exposition of the Art for the Use of Engineers, Students and Others interested in the Installation or Operation of Electrical Plants,' might fairly lead one to look for an encyclopedia or library even. The book is rather overloaded by its title.

The author has made excellent choice of his matter. The book is remarkably free from 'padding' and as we should expect in a work by Prof. Crocker, the form in which the topics are presented is direct and clear.

Like Oliver Twist, however, the reader is often inclined to ask for more of the same sort.

The student or engineer will find it helpful, if not complete. And we venture the assertion that the general reader and the "Others interested in the Installation and Operation of Electrical Plants' will find this on the whole the most satisfactory work published.

A. S. KIMBALL.

WORCESTER POLYTECHNIC INSTITUTE.

Our Native Birds of Song and Beauty. By H. NEHRLING. 4°. George Brumder, Milwaukee. Part XIV. June, 1896.

Again it is our pleasant duty to announce the appearance of another part of Nehrling's meritorious work on North American Birds.

It opens with an excellent colored plate of the Dickcissel by R. Ridgway. The male is singing in a field of red clover, with the mother on her nest below. Another plate by Goering shows the meadow lark and the bobolink, and also the yellow-headed and red-winged blackbirds. The text treats of these species and also of several of the true orioles—Audubon's, Scott's, the hooded, orchard and Baltimore. The biographies, as in previous parts, take one into the woods and fields and marshes, where the birds live, and introduce him to the surroundings before bringing in the subject of the sketch. The matter on geographic distribution has received a little more attention than usual, and considerable information is given on food habits.

The announcement is made that two more parts will complete the present (2d) volume. This is good news, and we heartily commend the book to those who wish to procure, at a reasonable price, a reliable work, with colored plates, on the haunts and habits of North American birds.

C. H. M.

Die Haustiere und ihre Bezeihungen zur Wirtschaft des Menschen. Eine geographische studie, VON EDUARD HAHN. Leipzig, Duncker & Humblot, 1896. 8°, pp. 581.

In this work the author has brought together in convenient form a large mass of facts concerning domesticated animals. He begins with the dog and ends with fish. Besides the ordinary domesticated mammals, he includes the yak, buffalo, deer, camel, lama, rabbit, cavy, and ferret. The number of birds treated is also considerable.

In dealing with the origin of the various breeds, the author usually quotes eminent authorities, rarely advancing views of his own. Footnote references are given in profusion, so that those interested in following up the subject shall not want for material.

The systematic part of the work, in which each animal is discussed at length, is followed by a geographical study, in which the several countries are discussed with respect to their domesticated animals.

C. H. M.

The Gypsy Moth. A Report of the Work of Destroying the Insect in the Commonwealth of Massachusetts, together with an account of History and Habits, both in Massachusetts. and Europe. By E. H. FORBUSH, Field Director, and C. H. FERNALD, Entomologist to the State Board of Agriculture. Boston. 1896.

The successive steps in the great experiment in economic entomology which has been carried on by the State of Massachusetts during the last five years are admirably portrayed in this volume. Never in the history of this country has so much money been spent by a State or by the General Government in fighting insects as has been used by Massachusetts against this one species, and it is most fortunate that the work has been in efficient hands and that no political jobbery has been connected with it since its start. Whatever the ultimate result of the experiment may be, it cannot fail to have been most instructive as bearing upon future work. The report is an admirable summary of the entire investigation. Mr. Forbush takes up the first half of the volume, some 250 pages, with a history of the gypsy moth in America, carefully detailing year by year the work of the State Commission down to and including the year 1895, following with a chapter on the increase and distribution of the insect, another on the methods used for destroying it, another on the influence of birds in the destruction of the species, and a final chapter on the progress of extermination. He treats fairly the obstacles to extermination, the principal ones being the enormous reproductive capacity of the moth, its very numerous food plants and the dense population of the infested region, which increases the danger of local distribution and reinfestation by the constant passing and repassing of infested centers by men and animals. In spite of these obstacles, however, Mr. Forbush shows that the insect has been locally exterminated, and argues that with sufficient appropriations it may be generally exterminated. He thinks that the policy of control or extermination of insect pests by government commissions, which has been so successful in certain European countries, might be applied in this case by the government of the United States.

The greatest scientific interest attaches to the second part of the report, which has been prepared by Prof. Fernald. It includes a full bibliography and consideration of the distribution of the species in other countries, the methods used to destroy it abroad, an elaborate account of its life history, based upon the most careful original observations, a list of the plants upon which the insect has been known to feed in Massachusetts, another list upon which it has been known to feed in Europe, and, by comparison with these, a very small list of the plants upon which it will not feed. There is further a section on the anatomy of the adult insect and a full consideration of the natural enemies which affect the species both in Europe and in Massachusetts, and the part concludes with an elaborate account of the experiments which have been made with insecticides.

The portion of the report dealing with the biology of the species contains many sections of much importance. The exact experiments upon the amount of food, on the effects of temperature, on hermaphroditism, on polygamy, on assembling and on parthenogenesis are of particular interest. The experiments with insecticides show many results which are most surprising, and none more so than the feeding of caterpillars, for from five to ten days before causing death, upon leaves treated with strong arsenical solutions. In an interesting by-subject—the dying out of the species in England—Prof. Fernald advances a new theory. It has been stated by no less an authority than J. Jenner Weir that the gypsy moth has been exterminated in England simply by collectors. Prof. Fernald, however, is inclined to think that the darker color of the foliage and other surroundings in England have made the female moths more conspicuous objects to their enemies than they are on the continent of Europe, so that in the struggle for existence the species was exterminated before it had time to take on the darker color which would have protected it. The argument is a somewhat elaborate one, and this is simply the conclusion.

The volume is illustrated with a wealth of text figures and plates, and will forever stand as a monument to the enlightened energy of the State of Massachusetts and the practical and scientific ability of its authors.

L. O. HOWARD.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 263D MEETING, MAY 30, 1896.

THEO. GILL spoke of *The Characteristics of the Families Salmonidæ and Thymallidæ*, saying that in 1894 he had given definitions of the two based on modifications of the cranium, the presence or absence of epipleurals, and the development of the dorsal fin. The *Salmonidæ* were supposed to have the 'parietal bones separated at middle by the intervention of the supraoccipital,' while the *Thymallidæ* had 'parietal bones meeting at middle.' Mr. Boulenger has denied the existence or value of these differential characters. As to the relations of the parietal and supraoccipital bones he was fully justified. The Coregonines generally have the parietals contiguous, and therefore the distinction of the Salmonids from the Thymallids on that basis must be abandoned. But there appears to be no reason for further abandonment. The epipleurals are well developed in *Thymallus*, while none could be found in *Salmo*, *Salvelinus*, *Argyrosomus* and *Coregonus*. It was suggested that Mr. Boulenger might have considered the epicentrals, which are common to both the Salmonids and Thymallids, to be what was meant by epipleurals. At any rate, Prof. Evermann and Mr. Lucas had both reëxamined the question on specimens prepared by themselves and had reached the same conclusions as the speaker. There is no question about the difference between the dorsal fins of the two types. They may, therefore, be maintained as families differentiated by the combination of epipleurals and peculiar dorsal in the Thymallids and no epipleurals and normally constructed dorsal in the Salmonids.

Barton W. Evermann spoke of *The Fishes and Fisheries of Indian River, Florida.* Indian River is not a river at all, but a long, shallow salt-water lagoon shut off from the sea by a series of low and narrow islands.

The depth is usually not greater than 6 to 10 feet, and the density of the water varies from 1.013 to 1.019.

The total number of species of fishes now known from the river is 105, though further investigation will doubtless add many to the list.

Indian River is remarkable for the large number of important food fishes which it contains, no fewer than 25 species being handled by the fishermen. Among the most important may be named the following: Common mullet (*Mugil cephalus*), pompano (*Trachinotus carolinus*), bluefish (*Pomatomus saltatrix*), red drum (*Sciænops ocellatus*), spotted squeteague, or sea trout (*Cynoscion nebulosus*), and the mangrove snapper (*Neomænis griseus*). The mullet is by far the most abundant of the food fishes.

The fisheries of this river have developed along with the completion of the Florida East Coast Railroad, which now furnishes excellent facilities for the shipping of fish to Northern cities. At first Titusville was the only important fishing center, but now several points further south are equally important. The severe cold in the winter of 1894–95 caused a considerable increase in the number of fishing firms. Several growers of oranges and pineapples, finding their orchards ruined, have turned their attention, temporarily at least, to fishing.

F. A. LUCAS, *Secretary.*

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, JUNE 9, 1896.

PAPERS under the following titles were presented for publication:

'Contributions to a Knowledge of the Hymenoptera of Brazil; No. 1, Scoliidæ,' by Wm. J. Fox.

'The Correct Position of the Aperature of Planorbis,' by Frank C. Baker.

'The Mesenteries of the Lacertilia,' by E. D. Cope.

'Revision of the Slugs of North America, Ariolimax and Aphallarion,' by Henry A. Pilsbry and E. G. Vanatta.

Dr. Harrison Allen made a communication on forms considered specific, but which were merely instances of arrested development. He referred in illustration to certain species of *Vespertilio*, claiming that *lucifugus* is merely an arrested form of *gryphus*, the species *albescens* also being based on similar characters. He had applied the term pædomorphism to the condition which had been worked out, he believed, only among the bats and by himself. He held that the specific names of such forms were not valid and should be dropped.

Dr. Horn stated that many such instances of arrested developments were found among insects. He referred to the dimorphic males of *Eupsalis minuta*, a rhyncophorous beetle, on which a French writer had founded three species. The egg-depositing habits of the female and the assistance occasionally rendered by the male were commented on.

Botanical Section, June 8, 1896. Dr. Chas. Schaeffer, Recorder. A paper was read from Mr. Thos. Meehan on *Erigeron strigosus*. A tendency of the ray florets to become discoidal, together with an acceleration from the lingulate to the discoid condition, was noted. The hermaphrodite state of the flower is not established until the tubular condition becomes permanent.

Dr. Ida A. Keller recorded the fact that if a cold alcoholic solution of chlorophyl be treated with benzol, the chlorophyl will be extracted and float as a green film on the surface of the liquid.

Records were made by Mr. Stevenson Brown, Mr. Crawford and Mr. Williamson, of unusual distribution of species. EDW. J. NOLAN,
Recording Secretary.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE June meeting of the New York Section of the American Chemical Society was held on Friday evening, the 5th inst., at the College of the City of New York, Prof. A. A. Breneman presiding.

After the reading of the minutes the chairman of the Committee on Organization of the Chemical Club reported that at a recent meeting of the committee, held at the Board of Trade, much enthusiasm was shown, and the movement was making good progress.

A communication from the Joint Commission of the Scientific Societies of Washington in regard to the Senate bill 1552, intended to restrict, if not prohibit, vivisection, was taken up and acted upon.

The sentiment of the meeting was unanimous in the direction of preventing affirmative action by Congress on the said bill; and the following resolutions were unanimously adopted, after a full discussion, in which Profs. Sabin, Breneman, Doremus, Hale and McMurtrie participated.

Resolved, That the New York Section of the American Chemical Society most earnestly opposes the legislation proposed by Senate bill 1552, entitled 'A bill for the further prevention of Cruelty to animals in the Dristrict of Columbia.'

Resolved, That the proposed legislation is unnecessary and would seriously interfere with the advancement of biological science in that District; that it would be especially harmful in its restriction of experiments relating to the cause, prevention and cure of the infectious diseases of man and of the lower animals; that the researches made in this department of biological and medical science have been of immense benefit to the human race; and that, in general, our knowledge of physiology, of toxicology and of pathology, forming the basis of scientific medicine, has been largely obtained by experiments upon living animals, and could have been obtained in no other way.

Resolved, That physicians and others who are engaged in research work having for its object the extension of human knowledge and the prevention and cure of disease are the best judges of the character of the experiments required and of the necessity of using anesthetics, and that in our judgment they may be trusted to conduct such experiments in a humane manner, and to give anesthetics when required to prevent pain. To subject them to penalties and to espionage, as is proposed by the bill under consideration, would, we think, be an unjust and unmerited reflection upon a class of men who are entitled to our highest consideration.

Dr. C. A. Doremus read a 'Note on Presence of Oil in Boiler Scale.'

Mr. J. A. Matthews described 'A New Method of Preparing Phthalimid.'

The chair announced this as the last meeting of the season, and stated that the fall and winter meetings would probably be held in the same rooms. DURAND WOODMAN,
Secretary.

PROCEEDINGS OF THE TORREY BOTANICAL CLUB, MAY 27, 1896.

THE last regular meeting of the season was held in Hamilton Hall, Dr. Schneider occupying the chair. One new member was elected.

Dr. John K. Small read his announced paper: 'Notes on the Flora of Yadkin Valley, N. C.' He spoke of the character of the Yadkin River and the geology between Salisbury, N. C., and the district where the Yadkin becomes the great Pedee. He discussed the great similarity of Dunn's Mountain, N. C., and Stone Mountain, Ga., the fact strongly emphasized by the local species common to both localities. He then gave a running account of the general floral features of the Yadkin Valley and summarized the phenomena as follows:

I. Several new species have lately been discovered in that region, viz: *Acer leucoderma. Solidago Yadkinensis* and *Quercus Phellos* $\times$=*Q. digitata.*

II. Several typical members of the prairie or *plains* flora are perfectly at home there, as *Scutellaria campestris* and *Solidago radula.*

III. Plants thought to be confined to the granite outcrop of Georgia are common, viz: *Arenaria brevifolia* and *Diamorpha pusilla.*

IV. Alleghenian or subalpine species as *Waldsteinia fragarioides* and *Anemone trifolia* occur there.

V. One species, *Lotus Helleri*, is *endemic.*

VI. A typically northern and very local species *Solidago Purshii* reaches a greater development, and is more abundant than elsewhere.

VII. A normally tropical species *Portulaca pilosa* abounds in certain places.

VIII. Generally local plants are represented by *Clematis ochroleuca, Verbena riparia, Oxalis recurva* and *Aster ptarmicoides Georgianus.*

Remarks were made and a discussion followed on the growth of plants in regions which for long periods at a time are devoid of rain.

A number of cut flowers of *Arethusa bulbosa* were presented to the members by Miss Rachel Farrington, of Lakewood, N. J.

W. A. BASTEDO,
Secretary pro tem.

KANSAS UNIVERSITY SCIENCE CLUB.

AT the twelfth annual meeting, held at Snow Hall on June 4th, the following program was presented:

On *Hesperornis*, S. W. Williston; The Groups of Motive in the Plane, H. B. Newson; The Motion of a Semispherical Shell on a Horizontal Plane, A. Emch; New Methods of Demonstration in Botany, M. A. Barber; Theory of the Satellites of the Earth and Mars, E. Miller; Stratigraphy of the Fort Benton, W. N. Logan; Construction and Use of an Interference Refractometer, M. E. Rice; A New Species of Sabre-toothed Cat, E. S. Riggs; On Double Sulfates, H. P. Cady; Further Investigations regarding the Constituents of the Dandelion Root, L. E. Sayre; Analysis of a Gypsum from Marshall County, L. Page; Analysis of House Paints, W. R. Mason and E. L. McCoy; Certain Principles in the Construction of Disruptive Discharge Coils, A. St.C. Dunstan; Some Conditions Governing the Deposition of the Lead and Zinc Ores in Southeast Kansas, E. Haworth; Variable Constitution of a Fresh Egg, James Lear and L. E. Sayre; Comparative Chaetotaxy of Diptera, H. W. Menke; Analysis of 'Natural Plaster' from Reno County, L. Page.

NEW BOOKS.

Thirteenth Annual Report of the Bureau of Ethnology. J. W. POWELL. 1891–2. Washington, Government Printing Office. 1896. Pp. lix+462.

Year Book of the United States Department of Agriculture, 1895. Washington, Government Printing Office. 1896. Pp. 656.

Report of Work of Agricultural Experiment Stations of the University of California for the Year 1894–95. Sacramento. 1896. Pp. xii+481.

Lehrbuch der vergleichenden Mikroskopischen Anatomie der Wirbeltiere. ALBERT OPPEL. Erster Teil. Der Magen. Jena, Gustav Fischer. 1896. Pp. viii+543.

Anleitung zur Microchemischen Analyse. H. BEHRENS. Heft III. Hamburg and Leipzig, Leopold Voss. 1896. Pp. vii+135.

Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland. London, Charles Griffin & Co., Lt'd. 1896. Pp. iv+262. 7s. 2d.

Long Life. Volume III. C. A. STEPHENS. The Laboratory, Norway Lake, Maine. 1896. Pp. 218.

The Oswego Normal Method of Teaching Geography. AMOS W. FARNHAM. Syracuse, N. Y., C. W. Bardeen. 1896. Pp, 127. 50 cts.

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