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// SCIENCE

NEW YORK, JULY 7, 1893.

HYDRAZOIC ACID: A NEW FORM OF APPARATUS FOR ITS PREPARATION; ITS PHYSIOLOGICAL ACTION.

BY CYRIL G. HOPKINS, SOUTH DAKOTA AGRICULTURAL COLLEGE, BROOKINGS, SOUTH DAKOTA.

MOST of the text-books on the subject of chemistry in use at the present time still recognize but one compound of hydrogen and nitrogen, viz., ammonia. There are, however, now known to science, several compounds of these two elements. Of these the most important are ammonia, NH_3; hydrazoic acid, HN_3; and hydrazine, N_2H_4. There is a remarkable difference in the properties of the first two substances. Ammonia, the volatile alkali, has very strong basic properties, uniting directly with acids to form the ammonium salts. Only with the strongest basic elements does it act like an acid, forming sodium amide, $NaNH_2$, with sodium, and potassium amide, KNH_2, with potassium.

Hydrazoic acid, on the contrary, is a comparatively strong acid. Being a binary compound of hydrogen and nitrogen, it might well be called *hydronitric* acid, after the analogy of hydrochloric acid, hydrobromic acid, etc. Its structural formula is represented thus:—

$$H - N \begin{matrix} / N \\ \quad \| \\ \backslash N \end{matrix}$$

Its hydrogen atom is readily replaced by metals and radicals, the salts of hydrazoic acid being thus formed. The ammonium salt contains only hydrogen and nitrogen, and is formed by direct union of ammonia and hydrazoic acid:—

$$NH_3 + HN_3 = NH_4N_3 = N_4H_4.$$

Hydrazoic acid also unites with hydrazine, another compound of hydrogen and nitrogen, possessing the formula

$$N_2H_4, \text{ or } \begin{matrix} NH_2 \\ | \\ NH_2 \end{matrix}.$$

This substance, hydrazine, or diamine, as it is sometimes called, bears to ammonia the same relation that ethane, C_2H_6, or $\begin{matrix} CH_3 \\ | \\ CH_3 \end{matrix}$, bears to marsh gas, CH_4; or that diphenyl, $\begin{matrix} C_6H_5 \\ | \\ C_6H_5 \end{matrix}$, bears to benzine, C_6H_6. Like ammonia, hydrazine possesses strong basic properties. With hydrazoic acid it forms two compounds by direct addition:—

$$\begin{matrix} NH_2 \\ | \\ NH_2 \end{matrix} + HN_3 = \begin{matrix} NH_3N_3 \\ | \\ NH_2 \end{matrix} = N_5H_5,$$

and

$$\begin{matrix} NH_2 \\ | \\ NH_2 \end{matrix} + 2HN_3 = \begin{matrix} NH_3N_3 \\ | \\ NH_3N_3 \end{matrix} = N_8H_6.$$

Thus we have at least six compounds of the elements hydrogen and nitrogen, their general formulas being:—

$$NH_3,\ N_2H_4,\ N_4H_4,\ N_5H_5,\ N_8H_6, \text{ and } HN_3.$$

Heretofore hydrazoic acid and its derivatives have been made only by reactions[1] of organic chemistry; but within the past few months a method has been devised by Wislecenus[2] by which the acid is made entirely from inorganic substances. This is done by first treating molten metallic sodium (or potassium) with dry ammonia gas, and then treating the sodium amide thus formed with dry nitrous oxide. The sodium salt of hydrazoic acid is thus formed; and, by treating this with dilute sulphuric acid, the hydrazoic acid itself is liberated, and may then be distilled off with water, thus giving a dilute aqueous solution.

Wislecenus performed the operation in a small porcelain boat within a glass tube. The porcelain is strongly attacked by the sodium compounds, and the yield of hydrazoic acid which Wislecenus obtained was nearly 50 per cent of the theoretical amount, and, besides, only a small quantity of the acid (about one-half a gramme) could be made at a time.

These objections to the apparatus used by Wislecenus induced the author to seek for a better form of apparatus with which to prepare the acid.

A cylindrical copper air-bath was selected, which was provided with two mica windows placed opposite each other, through which any operation that was carried on within the bath could be easily observed. The bath was about fifteen centimetres from top to bottom and of about an equal diameter. The cover was of heavy asbestos board. In the centre of this a large circular opening was made, through which a glass beaker of 750 cubic centimetres capacity was inserted into the bath until its rim rested upon the asbestos board, the bottom of the beaker not being allowed to touch the bottom of the bath. A small quantity of clean sand was placed in the bottom of the beaker, and upon this a small iron sand-bath, hemispherical in shape, and having a capacity of 100 cubic centimetres. The mouth of the beaker was closed with a large flat cork, provided with three holes. Through the central hole passes a glass tube which reaches a little way into the iron dish, and through which the gases are conducted into the apparatus. The second hole carries a short exit tube, and the third a thermometer.

Neither the metallic sodium nor the compounds formed have any action upon the iron dish, and the reactions which take place in the dish can be readily observed through the mica windows of the air-bath and the glass beaker.

The ammonia gas was obtained by gently heating on a water-bath a flask containing strong ammonia water, and the nitrous oxide by the decomposition of ammonium nitrate by heat. The gases were dried as directed by Wislecenus, by passing them over soda-lime and solid potassium hydroxide.

To perform the operation 25 grammes of metallic sodium were placed in the iron dish, the temperature of the bath raised to $300° - 360°$ C., and dry ammonia gas conducted in and delivered just above the surface of the molten sodium. The specific gravity of sodium being less than that of the amide formed, the metal floats on the surface until the action is finished. The reaction is represented by the equation:—

$$NH_3 + Na = Na\,NH_2 + H.$$

When the globules of sodium had all disappeared, the nitrous oxide was substituted for the ammonia, and the temperature of the bath lowered to $230° - 250°$ C. Two reactions now take place. The two atoms of hydrogen in the sodium amide are replaced by the bivalent group, N_2, contained in the nitrous oxide, the hydrogen and oxygen uniting to form water. This then reacts with a second molecule of sodium amide, forming sodium hydroxide and ammonia:—

$$NaNH_2 + N_2O = (NaNN_2 = NaN_3) + H_2O, \text{ and}$$
$$NaNH_2 + H_2O = NaOH + NH_3.$$

The sodium compounds have a strong tendency to creep over the edge of the iron dish as fast as they are formed; but they only fall upon the sand in the bottom of the beaker, from which they are readily dissolved out by water.

When the odor of ammonia ceases to be given off, the reaction is complete. The apparatus was allowed to cool, the mixture of sodium hydroxide and the sodium salt of hydrazoic acid was dis-

[1] Berichte der deutsch. Chem. Gesellschaft (Curtius), xxiii., 3023; xxiv., 3345. Ibid (Noeting and Grandmongin), xxiv., 2546.

[2] Ibid, xxv., 2084.

solved in 500 cubic centimetres of water, and then dilute sulphuric acid added till the hydrazoic acid was liberated. The solution was then distilled till the distillate ceased to give a precipitate with silver nitrate.

The distillate was then diluted to a definite volume and its strength determined by titration with standard ammonia solution. The yield of the acid was 87 per cent of the theoretical, 500 cubic centimetres of nearly 4 per cent solution being obtained.

A part of the acid solution was neutralized with potassium carbonate, and evaporated to crystallization. Beautiful, tabular, transparent crystals of the potassium salt, KN_3, were formed.

The salts of hydrazoic acid, excepting the salts of the alkali metals and the metals of the alkaline earths, are explosive. In some respects the acid resembles hydrochloric acid. With soluble silver salts a white precipitate, AgN_3, is formed. Lead acts similarly. These salts explode very violently when heated.

The most remarkable property of hydrazoic acid and its soluble salts is their physiological action. In this respect they resemble the nitrite of amyl, $C_5H_{11}NO_2$, having a marked influence upon the action of the heart. The author found by experiment that one-tenth of a grain of the potassium salt, KN_3, dissolved upon the tongue (the resulting solution not being swallowed, but ejected from the mouth) was sufficient to increase the pulse from 96 beats per minute to 153. This required only five minutes' time after the dose was taken. This rate of heart-beat is not sustained, however. A sudden and rapid reduction takes place, and ten minutes after the dose was taken the heart was giving 60 feeble beats per minute, making a total variation of 97 beats per minute. Considering the fact that this effect was produced by the small quantity of the substance which was absorbed by the mucous membrane of the tongue, this property is certainly remarkable. The vapors of the hydrazoic acid produce similar effects when inhaled.

The laboratory work reported in this article was performed in the chemical laboratory of Cornell University; and the author wishes to acknowledge that the success of the work was largely due to the aid and direction given by Dr. W. R. Orndorff. Thanks are also due him for his kindness in reading and correcting the manuscript.

ON PROTOPTERUS ANNECTENS.

BY DR. R. W. SHUFELDT, WASHINGTON, D.C.

THERE has been very recently published in the Transactions of the Royal Irish Academy (Vol. XXX., Part III., pp 109–230, Plates vii. to xvii.) the long-delayed work of Professor W. N. Parker of the University College, at Cardiff, Wales, "On the Anatomy and Physiology of *Protopterus annectens*." Through the courtesy of its author, a reprint of that most valuable quarto is now before me, and it is my wish to write a brief notice here in regard to it. The elaborate manner in which the Transactions of the Academy are published is too well know to require remark, but in the present instance it is impossible to pass this work without a word upon the truly superb plates that illustrate it. These, some ten in number, were chromo-lithographed by Professor Parker's younger brother, M. P. Parker, and printed by West, Newman. They present us with much of the anatomy and histology of *Protopterus*, and are throughout perfect masterpieces of the kind, and of the very highest order of merit.

As is well known, this genus formerly was written *Lepidosiren*, the South American species being *L. paradoxa*, and the African one *L. annectens*,[1] and among the first to pay any attention to it, of a reliable nature, was Sir Richard Owen, who, in 1839–1841, published his "Description of *Lepidosiren annectens*" in the Transactions of the Linnæan Society of London (Vol XVIII.), since which time naturalists have never ceased to furnish various accounts of the biology of this extremely important form, but usually based, as Professor Parker remarks, upon badly preserved material. Our present author was far more fortunate as he had perfectly fresh specimens to work upon. Of these he has said in his "Introduction," that "All my material, with the exception of two specimens, purchased last autumn, were placed at my disposal by Professor Wiedersheim. These were received alive direct from the neighborhood of the Gambia, and to Dr. J. Beard is due the credit of having arranged for their transport. While in the torpid condition about one hundred specimens had been dug out, each surrounded by a clod of earth,[2] and the clods were then packed together in open crates. In this manner they travelled without harm, nearly all of them being alive and in a healthy condition on their arrival in Freiburg. On being removed from the clods, they were, by the kind permission of Professor Hildebrandt, placed in a large wire cage, sunk beneath the water in a basin used for the culture of water plants in one of the hot-houses of the Botanical Gardens, in which a constant temperature of 22.5° C. was maintained."[3] . . . "Protopterus lives probably to a great age, and this supposition is supported by the somewhat incredible statement of the natives mentioned by Stuhlmann, that some specimens reach a length of six feet. From the observations of Hyrtl and Bischoff, it appears that Lepidosiren also attains a large size, reaching, at any rate, three feet in length" (p 112).

It was found that *Protopterus* grows very rapidly, has great vitality, and, although able to sustain fasts, is exceedingly voracious, devouring all the abundant snails, earth-worms, and small fish given them, and then killing and eating each other, making it difficult in the extreme to preserve the specimens.

Protopterus is most active at night, and appears to keep mostly to the shallow water, where they move deliberately about on the bottom, alternately using the peculiar limbs of either side, though their movements do not seem to be guided by any strict regularity. "Gray has compared these movements with those of a Triton, and several other observers have noticed them. The powerful tail forms a most efficient organ for swimming rapidly through the water."

"It is well known that Protopterus comes to the surface to breathe at short intervals, and thus it is evident that the lungs perform an important, if not the chief, part in respiration during the active life of the animal. The air passes out again through the opercular aperture, and the movements of the operculum itself indicate the fact that bronchial as well as pulmonary respiration takes place."

Externally, the sexes present no characters whatever distinguishing them apart, and even in immature specimens it is difficult to tell ovary from testis.

In the present brief notice it will be impossible for us to even abstract the positive advances Professor Parker has made for us in our knowledge of both the anatomy and physiology of this instructive Dipnoan. He sums up handsomely on page 213, under his "General Abstract, Summary of Chief Results, and Conclusions."

His researches convince him that, although many points of resemblance exist between Protopterus and certain Elasmobranchs and Ganoids on the one hand, and on the other to some of the lower Amphibians, it exhibits numerous distinctive characters of its own, both primitive and specialized, and so, together with Lepidosiren and Ceratodus, must be placed at a great distance from either class. Further, he believes that the Dipnoi, as a group, should not be retained among the fishes, still less among the Amphibia.

[1] Dr. Günther classifies them as follows: —

		Suborder III.	Families.	Genera.
ORDER II.—Ganoidei	Dipnoi.		1. Sirenidæ	Lepidosiren, incl. Protopterus Ceratodus.
			2. Ctenododipteridæ	Two extinct genera, Dipterus and Heliodus.
			3 Phaneropleuridæ	Extinct Phaneropleuron.

And he remarks that "Two species are known, L. paradoxa, from the system of the river Amazon, and L. (Protopterus) annectens, which abounds in many localities of the west coast of Africa, is spread over the whole of tropical Africa, and in many districts of the central parts forms a regular article of diet."

[2] To those less familiar with the habits of this extraordinary fish, I would say that the species averages about four feet in length, and is an inhabitant of the Gambia River in Africa. They bury themselves in the mud during the dry season, making a kind of nest in which they pass a period of torpidity. Here they may remain for the best part of the year, but on the return of the wet season resume again their aquatic mode of life.

[3] In 1889, it will be remembered, Stuhlmann also gave an interesting account of Protopterus, published in German. (Berlin.)

Highly specialized in some respects, in both Protopterus and Lepidosiren, this specialization is largely due to a change of habit, and that, undoudtedly, these two types are, genericly, very distinct.

In conclusion, I may simply add that this classical work will, in the future, prove to be one of the very greatest value to all students of the morphology of the Amphibia and of Pisces, as it will be indispensible to the general biologist

OBSERVATIONS ON A CYCLONE NEAR WILLIAMSTOWN, KANSAS.

BY E. H. S. BAILEY, UNIVERSITY OF KANSAS, LAWRENCE, KAN.

A SEVERE and fatal cyclone visited a small area of country in the Kaw valley, in Jefferson County, on June 21, at about six o'clock in the evening, and the peculiar topography of the country gave an opportunity to make some observations that may be of scientific interest. The valley at this point is about two miles in width, the river running nearly east. On the south side it is bounded by bluffs about a hundred feet in height, and on the north side there is a strip of level meadow, something over a mile in width, before one reaches the bluffs, which are of about the same height as those on the south side.

The general trend of the broad valley is east, but at a point a mile or so beyond where the cyclone lifted the river runs toward the southeast for perhaps a mile. On the particular afternoon in question the weather had been extremely hot and sultry, the mercury ranging between 90° and 95° F. The weather had been warm and dry, with only one local shower for about two weeks. About two hours before the cyclone burst upon the valley there was a gathering of clouds in the northwest, with thunder and lightning. A short time before the storm burst an ominous stillness was noted, and a sudden darkening of the sky. During the heaviest of the storm a peculiar green tint of the sky was noticed in the locality.

As the storm came from the west, it seemed to settle near the ground at the base of the bluff, and, wherever the bluff was not broken by lateral valleys, its path was about one-half on the side of the hill and the other half on the sloping meadow to the south.

Wherever the cyclone crossed the course of lateral ravines, even if they were quite narrow, it dipped down into them and destroyed trees and buildings. It was not swerved from its general eastward course even at one point where a broader valley joined that of the Kaw. At this point, as the country was heavily timbered, there was a special opportunity to observe the action of the wind. Elm and walnut trees, two or three feet in diameter, were either torn up by the roots, laid prostrate, or twisted off fifteen or twenty feet from the ground. Here the track of the cyclone, where it did appreciable damage, was a little less than 600 yards in width. There were, occasionally, wrecked chimneys and slightly injured roofs on the outer edges of this path. All along the course of the storm the debris was deposited in the peculiar way that is characteristic of these furious whirlwinds. The material north of the centre of the track was deposited in lines from northwest to southeast, and that on the south side of the centre in lines running from southwest to northeast. In the centre of the track there was a tendency to distribute the material in an east and west direction. A line of telephone poles on the south side were laid in parallel lines, thus, / / / / /. Fields of grass and wheat were beaten to the ground and the stalks laid in the directions above noted: W. \ \ \ \ \ \ over / / / / / / → E. The wires of the telephone line and of the barb-wire fence were lifted into the tree-tops about fifty feet north of their original position. There was a little debris deposited on the west side of some of the buildings demolished, but most of it was carried along the track and thoroughly pulverized. Strong, new farm wagons were wrenched to pieces, and the spokes were even broken off near the hub, before they were deposited half a mile away.

The terrible force of the wind could be seen in the beheading of the wheat, the uncovering of potatoes in the hills, the transportation of grave-stones 300 yards, and the picking of all the feathers from the chickens

One of the most interesting effects that was noticed was upon the trees that were left standing or laid prostrate and bereft of every vestige of foliage and of nearly all the bark. All the wood on the west side of these trees, often being exposed by having the bark torn off, was roughened as if by a sand blast; while that on the east side was smooth. This roughness was uniform, showing that it was not produced by occasional missiles hurled through the air. This roughening, if not produced by the actual friction of the air, must have been produced by the sand and gravel in the air, or by the rain that beat against the surface.

Some who witnessed the storm saw the clouds of dust that accompanied the wind, so the sand-blast theory is no doubt the correct explanation.

The most serious work of destruction was accomplished just before the cyclone lifted. Here the valley broadened out towards the north, and the bluff for a distance of a mile or more disappeared. With one last sweeping blow the storm lifted, and the only other evidence of its work was a partially demolished barn. Just at the point where the intensity seemed concentrated, the path was much narrower than farther west. The strip of land devastated was about five miles in length. From the manner in which it followed the base of the bluff, one would infer that had it not been for this obstruction the storm would have passed off towards the northeast instead of pursuing, as it did, a direction a little south of east.

NOTES ON THE COPEPODA OF WISCONSIN.

BY C. DWIGHT MARSH, RIPON, WISCONSIN.

In the waters of Wisconsin and in the adjacent lakes are found the following twenty-one species of free-swimming copepods: *Diaptomus sanguineus*, Forbes; *D. leptopus*, Forbes; *D. pallidus*, Herrick; *D. sicilis*, Forbes; *D. ashlandi sp. nov*; *D. minutus*, Lillj.; *D. oregonensis*, Lillj.; *Epischura lacustris*, Forbes; *Limnocalanus macrurus*, Sars; *Cyclops americanus*, *sp. nov.*; *C. brevispinosus*, Herrick; *C. pulchellus*, Koch; *C. navus*, Herrick; *C. parcus*, Herrick; *C. leucarti*, Sars; *C. signatus*, Koch; *C. modestus*, Herrick; *C. fluviatilis*, Herrick; *C. serrulatus*, Fischer; *C. phaleratus*, Koch; *C fimbriatus*, Fischer.

Although two of these, *D. ashlandi* and *C. americanus*, are new species, it is not probable that they are peculiar to the Wisconsin fauna. The copepods of America have thus far received very little attention, the only important publications on the subject being by three men, Professor Cragin, Professor Herrick and Professor Forbes. If more were known of our copepods it is probable that it would be found that there are few local differences in the faunæ of our northern States. The copepods are readily transported from one body of water to another and, without change of structure, seem to endure great changes in their environment. In fact, half of our species of cyclops are not only widely distributed in America, but are identical with those of Europe. Those that may be considered distinctly American are closely allied to well-known European forms.

C. leucarti is found in nearly all parts of the world where collections have been made and, so far as can be inferred from the published descriptions, varies but little, even in the minute details of its structure.

C. americanus closely resembles *C. viridis*, and is probably the species which has by other American authors been identified with *viridis*. Although there seems to be good reason for separating it from the European species, the similarity of the two forms is so great that it is only by a close examination that the structural differences become apparent.

It is very possible that *C. brevispinosus* should be considered a pelagic variety of *C. americanus*, thus reducing by one the number of species peculiar to America. There is some reason, too, for supposing that *C. navus* is not specifically distinct from *C. pulchellus*.

C. pulchellus is the common pelagic form of the Great Lakes. Although found in smaller lakes, it is more commonly replaced by *C. brevispinosus*, which is a species of wide distribution.

C. navus is found only in stagnant pools.

The most common of all our species is *C. serrulatus*. Rarely is a collection without this form, which seems to adapt itself easily to very different surroundings. It has, however, wide limits of variation, and it is, perhaps, due to this fact that it is so universally distributed. The littoral and pelagic forms are so different that they have been considered specifically distinct.

C. modestus is a rare form. Thus far it has been found in only a single locality in Wisconsin.

None of the American species of *Diaptomus* is identical with those of Europe, although in some cases the relationship is very close.

D. sicilis is the common pelagic form of the Great Lakes, but occurs also in smaller bodies of water. *D. ashlandi* has been found only in the Great Lakes.

The most common species in the smaller lakes is *D. oregonensis*. This was described by Lilljeborg from specimens collected in Oregon, and probably is common through our northern States. *D. minutus* is common in Newfoundland, Greenland and Iceland. It occurs in some of the small lakes in northern Wisconsin and in Green Lake. It is likely that it occurs quite generally through the northern part of North America, and possibly central Wisconsin is near its southern limit.

Especial interest attaches to the fauna of Green Lake. This is about seven miles long, with a maximum depth of nearly two hundred feet. While the pelagic fauna of the Great Lakes is quite distinct from that of the smaller lakes, we find in Green Lake both sets of faunæ. *D. sicilis* and *Limnocalanus macrurus* I have not found outside the Great Lakes except in Green Lake. But besides these species the pelagic fauna of Green Lake includes *C. brevispinosus* and *C. fluviatilis*, which are the characteristic species of the smaller lakes.

A more detailed account of the Wisconsin copepoda will soon appear in the Transactions of the Wisconsin Academy.

THE HILLOCK AND MOUND FORMATIONS OF SOUTHERN CALIFORNIA.

BY DANIEL CLEVELAND, SAN DIEGO, CALIFORNIA.

Some time ago, in an article upon the nest of the trap-door spider, which appeared in *Science*, I mentioned the low mounds in which these nests in many districts are so often located, as being in themselves an interesting formation. I now propose to offer an explanation of the origin of the formation.

Let me begin by saying that these mounds are not confined to this vicinity, for they extend throughout this State and elsewhere on this coast and in Texas; but they are more numerous and better defined here than elsewhere; they are, in fact, a characteristic of certain large areas of our territory. For this reason, among others, I believe this to be the best field for observing and investigating this remarkable formation.

Lying just back of the commercial portion of the city of San Diego there is a great mesa or table-land, which stretches away for a distance of from eight to ten miles to the valleys at the base of the Coast Range. It possesses a rich brown soil, holding in many places considerable aggregations of loose stones which have drifted down from the neighboring mountains and been ground into pebbles. Here for miles the surface is gently undulating, with low mounds lying as close together and as numerous, considering their size, as the ground will permit. These mounds are from one to three feet in height above their bases, and are from ten to thirty feet in diameter, separated by greatly varying areas which in their depressions in many places contain accumulations of cobble stones. An unscientific person seeing these plains for the first time might imagine that they had once been densely populated by large burrowing animals which had left these hillocks to mark their subterranean dwellings.

Several theories have been advanced to account for this formation. The most probable hypothesis is suggested by the nature of the soil and the peculiar vegetation of these plains. The soil itself is dry and hard for the six to eight months constituting the rainless season. During the time of heavy rains it is soft and mellow. During the time of drought it becomes almost as hard as stone.

Each mound, it is evident enough, marks the former home of a shrub or, as was almost always the case, of a cluster of shrubbery, to whose agency the mound in large degree owed its existence. Three shrubs—Rhus laurina, Nutt.; Simmondsia California, Nutt.; and Isomeris arborea, Nutt.—are conspicuous among the large vegetation of these plains, and have been very important factors in the formation of these mounds. Of these plants Rhus laurina is the largest and is much more abundant than the other two. It is an interesting fact that these three shrubs are confined to this section of California, mostly to this county, and that they were all first collected at San Diego about 1840, and were named by the eccentric naturalist Thomas Nuttall. He established the genera Simmondsia and Isomeris The habits of these plants peculiarly fit them for their office of mound builders. They grow in small compact groups. Many stems rise from the roots, which are large and spreading. The foliage of Rhus and Simmondsia especially is dense and falls close to the ground.

Dust blown by the steady trade winds of the dry season is arrested by the shrub and accumulates with the fallen leaves at its base, making a steady accretion of material. In this way a mound gradually rises about the plant, in time covering the lower branches and in the case of the smaller shrubs—Simmondsia and Isomeris—nearly or quite enveloping the whole plant. This process of mound building can still be seen in isolated hillocks. An examination of the older mounds confirms this theory. In the lower portion of the mound the earth is compact and indurated, while the surface soil is a light loam mixed with decayed and decaying leaves. The mound is protected from washing by the rains at the summit by the overhanging branches and foliage, and at the base by a compact mass of roots. Outside of the foliage and roots the process of erosion goes on steadily, though slowly, during the rainy season, when this soil is peculiarly susceptible to the action of water, and the hollows between the mounds are then formed.

When in the course of time the plant dies from natural decay, from being smothered by the drift that environs it or from the fires that sometimes sweep over these plains, the mounds, being deprived of protection, are attacked by wind and rain and gradually worn down. The mounds are thus made shallower and broader at the base, until from this steady subsidence they sink down and flatten out almost to the general level of the plain.

The presence of living shrubs upon the more perfect mounds and of masses of roots well preserved or in process of decay in mounds in subsidence, where no large growing vegetation has been seen for many years, and in the oldest and flattest mounds the disappearance of all traces of shrubs and roots, confirm our theory of mound formation and subsidence.

What the shrubs I have named—Rhus, Simmondsia and Isomeris—have effected in coöperation with the wind and rain in the formation of mounds in this section, has been accomplished elsewhere by other shrubs and trees. It is a familiar fact that upon the great prairies of Texas mats of timber are generally found upon the summit of hillocks, very much larger, of course, than the mounds of southern California, as those trees are larger than our shrubs.

CURRENT NOTES ON ANTHROPOLOGY.—XXXI.

[*Edited by D. G. Brinton, M.D., LL.D., D.Sc.*]

The Archæology of Oaxaca.

Two or three years ago the State of Oaxaca, in Mexico, established an Archæological Museum, and placed it in charge of the very competent and enthusiastic scientist, Dr. Nicolas Leon, of Michoacan, who had already won for himself a wide reputation as curator of the Museum at Morelia. Through some unfortunate political changes the modest appropriations awarded to both these institutions have been diverted into other channels. This is a matter of great regret to all who are interested in the preservation of the ancient monuments of Mexico and the further investigations into the numerous remains there found.

The State of Oaxaca especially has an archæological importance which attaches a unique value to the investigation of its remains. From the earliest days of which tradition records the echoes, it was the home of the Zapotecs, and the profoundest researches into the pre-Columbian origin of the Aztec and Mexican civilization point, not to the fabulous "Empire of the Toltecs," but to these Zapotecs as the tribe which first spread abroad the light of a higher culture, who invented the famous sacred calendar, so long the subject of astonishment to the learned, and who constructed edifices of brick and stone whose massive walls, strange ornamentation and remarkable architectural details, place them among the most impressive of any on the continent.

One of these was described, not for the first time, but with considerable care, by the engineer Aureliano Estrada, in the Memorias de la Sociedad Scientifica Antonio Alzate, of Mexico, last year. It is a mass of buildings crowning the summit of the Cerro de Quiengola, a mountain some 2,500 feet in height in the District of Tehuantepec. It presents thick walls of stone and burnt brick, circular and square towers, truncated pyramids and all the proofs of an extensive population.

It is sincerely to be hoped that these and numerous other remains in this state will be protected from destruction and thoroughly examined to the benefit of science.

The Basques and the Iberians.

An unusual number of papers and essays on questions relating to the ethnic position of the Basques and their possible relationship to the ancient Iberians, have appeared in France within the last year.

First, the linguists have had much to say. It is well known that Wilhelm von Humboldt in the first decade of the present century wrote an admirable analysis of the place-names throughout Spain, showing, he believed, by them, that the Basques at the time of the Roman conquest extended westward from the Pyrenees to the Atlantic coast. His conclusions have been alternately accepted and denied by special students of the tongue, and so they are to-day. Professor Julien Vinson, for example, a distinguished Basque scholar, says: "There is no historic proof, nor even scientific probability, that the Basque at any time occupied a much larger area than at present. The opinion that the Iberian peninsula or other parts of southwestern Europe were peopled by a race or races speaking a kindred dialect is based merely on etymologies, and must be considered a pure hypothesis."

Directly the contrary is maintained by M. J. F. Bladé, who observes: "Inasmuch as, in a large area surrounding the present territory of the Basques, altars are almost daily found inscribed to gods unknown among the Celts, and tombs bearing names certainly not Celtic, the conclusion appears justified that these names are ancient Basque, and that this tongue once spread over Aquitania and Iberia."

Meanwhile, the physical anthropologists have been at work. Dr. Lajard, in the Bulletin of the Anthropological Society of Paris, published the results of a comparison of ancient and modern skulls in the Canary Islands, with a large number from Portugal and Spain; reaching the result, that not only was the race of the Guanches of the Canaries identical with that of the old Iberians, but that both point to the still older race of Cro Magnon, as their near relatives. This does not take in the Basques, but leaves them to one side; while, as we certainly know that the Guanches were blonde Hamites, closely akin to the Rifians at Morocco, it places the Iberians along with the North Africans.

As for the present Basque population, they are reported by M. De Cartailhac as losing their language and diminishing in number. Even in the most remote and secluded districts, the deaths are more numerous than the births, owing to the rarity of marriages; and French and Spanish are in a fair way to drive out this curious and venerable tongue from its last refuge in the fastnesses of the Pyrenees.

Man in South America.

There is no part of the world that offers a more curious subject of speculation as to its future than the continent of South America, as was well set forth in an address before the American Geographical Society, by its President, Mr. Gardiner G. Hubbard.

That the Amazon river system alone drains a basin of fertile land, basking under a climate of perpetual summer, greater in area than the whole of Europe, is an astounding fact in itself. This vast territory is practically uninhabited. Its aboriginal population is disappearing, or has disappeared, and the whites who in sparce number take their place, scarcely pretend to come with the expectation of remaining. There are tracts as large as the whole of France, of which we know less than of any equal area on the globe. Tribes of men are living there who are yet absolutely in the Stone Age, and who, even by barter or distant rumor, never heard of the European race or the use of metals.

The question up to which Mr. Hubbard leads his reader is second in importance to none in anthropology—that of acclimation. Is it possible for the white race, when it shall be endowed with all the resources of art and science which it is soon to have in its grasp, successfully to fight against the terrible odds of a tropical climate? He quotes in his favor the words of the historian, Buckle, and the naturalist, Bates; he might have added others of weight; but it cannot be doubted that most of the medical observers who have devoted themselves to this vast inquiry, lean to the opinion that never will the white race flourish under tropical skies

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NOTES AND NEWS.

THE fifth summer meeting of the Geological Society of America will be held Tuesday and Wednesday, August 15 and 16, in the Geological Lecture Room, Science Hall, University of Wisconsin. On account of the World's Congress of Geologists convening in Chicago, August 24, an invitation will be sent to geologists residing outside of North America to attend this meeting and present papers. A meeting of exceptional interest is anticipated. Fellows desiring to read papers should send titles and abstracts not later than July 15, in order to secure insertion in the preliminary list of papers. Matters for the programme, distributed at the first session, should be sent in by August 10. The meeting-room has facilities for lantern views, and members are invited to bring such illustrations. Matter sent by express or mail may be addressed in care of the Secretary, Room 32, Science Hall, University of Wisconsin, Madison, Wis. Packages should be clearly marked with the sender's name and prepaid. The excursions offered to the Fellows of the Geological Society of America are as follows: To the Lake Superior Region, to Devil's Lake, to the Dells of the Wisconsin, and to the Driftless Area.

— The Pope Manufacturing Company, of Boston and Hartford, makers of the Columbia bicycles, have engaged of late in a novel enterprise. They offered some time ago to give one of their bicycles to the school teacher who should be most successful in detecting errors in the school books in use in this country, provided the errors were determined to be such either by the authors and publishers of the books or by an impartial board of examiners. Typographical mistakes and disputed points in history and opinion were not to be included, but only errors of fact or of statement which could be shown to be such. Responses came from all parts of the country and the company have already awarded several of their bicycles to the persons who complied with the conditions of the gift. The kind of errors detected may be learned from the pamphlet entitled "Errors in School Books," which the Pope Company have issued, and which has now appeared in a second edition. Some of the errors are hardly more than ambiguous statements; others are erroneous dates; while others still are misstatements of scientific fact, as, for instance, the statement in a geographical work that the earth moves around the sun in a circle. Most of the publishers took the criticisms good naturedly, and whenever they were shown to be well founded corrected the books accordingly. The Pope Company have now renewed their offer of a bicycle to each of the five persons who shall send them the greatest number of errors in school books before September 1, 1893, the present competition to be open to all persons and not to teachers alone. That errors in school books are specially mischievous is obvious, since the young people who use the books have not, as a rule, the means of detecting them, and though the class of errors to which the Pope Manufacturing Company have devoted themselves are not perhaps the worst, they are the most easily detected and proved, and we should be glad if this new enterprise might result in the exposure and correction of every one of them.

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

NOTES ON THE FLORA OF LONG ISLAND.

BY SMITH ELY JELLIFFE, M.D., BROOKLYN, N.Y.

THE flora of Long Island is one of some degree of richness, which upon a casual observation would seem to be a somewhat anomalous statement, for it would appear that a sand waste a few miles wide and about a hundred miles in length would hardly be a place upon which a rich or abundant flora could flourish.

Long Island, so geologists tell us, is a portion of the terminal moraine of the glacier that stretched across the country from east to west; traversing the entire length of the island there is a rocky ledge, the so-called "back bone," from which the land falls in more or less steep descents to the north, and in long gradual slopes southward; the whole coast is rich in fresh and salt water marshes, which are more pronounced upon the southern coast.

The earliest notices upon the subject are to found in a paper published in 1807, entitled "Plantæ Plandomensis," or a catalogue of the plants growing near Plandome, Queens County, by Caspar Wistar Eddy. In 1835, J. B. Zabriskie published a "List of Plants Growing near Erasmus Hall, Flatbush," and from 1843 to 1853 John Torrey M.D., in his publication on the "Flora of New York," included many Long Island plants. In 1874, E. S. Miller and D. W. Young published their "Catalogue of the Plants of Suffolk County," to which additions were made in the Bulletin of the Torrey Botanical Club. This journal also contains many notes upon the island flora. C. H. Peck, N. L. Britton, A. H. Hollick, Geo. D. Hulst, W. H. Rudkin, W. H. Leggett, J. L. Zabriskie, Mrs. E. G. Britton, Mrs L. D. Pychouska, F. E. Tillinghast and others have contributed notes from time to time upon new or interesting plants found on the island.

In round numbers about 1500 phænogamous plants have been recorded; the work in the cryptogams has been scanty, yet the writer has records of upwards of 750 species, which promises much for the numerical value of this portion of the flora when more completely studied.

The most characteristic of the plants are found in the salt marshes and along the sands of the sea coast, here are a number of interesting grasses and sedges, including Fuirena squarrosa, Heleocharis Robbinsii, rostellata and melanocarpa, Scirpus subterminalis, Rhyncospora nitens, Calamagrostis Nuttalliana, Glycenaspfluitans, Eragrostis pectinacea and others; the salt-loving plants as Ranunculus cymbalaria, Lecheas, racemulosa, minor and major; Hudsonia tomentosus in quantities and H. ericoides, though much rarer, Prunus maritima and several of the more common forms are constantly to be found at almost all points along the southern shore. In the fresher marshes Spiranthes, Habenaria, Calopogon and Pogonia. Cypripidiun and Goodyera are intermingled with rush and sedge and grass.

Along the ridges and in the higher lands the Composites, Labiates and Graminiæ are widely distributed, there seeming to be a nearly equal distribution throughout the three counties. In general, however, the plants found in Suffolk county are among the most characteristic, there being there some fifty or sixty plants that belong to the New Jersey pine-barren flora and whose presence is to be explained upon the geological grounds that this eastern portion of the island was at one time a portion of the Atlantic littoral plain. Among those plants found in Suffolk county, some of which are also to be met with in Queen county, there may be mentioned Camelina sativa, Reseda luteola, Drosera longifolia and filiformis, Ascyrum stans and Crux andreæ, Arenaria squarrosa, Polygala lutea, Quercus phellos, Cyperus dentatus and Cupressus thyoides, as of more particular interest. Recent investigations by Dr. A. H. Hollick, of Columbia College, have been directed to a better understanding of this portion of the flora, and interested botanists are referred to his papers in the Transactions of the New York Academy of Sciences.

The knowledge of the cryptogamic flora is still in its infancy. The ferns are well known and comprise the majority of the common Aspleniums and Aspidiums with here and there a more or less uncommon form, as Woodsia obtusa, Woodwardia angustifolia. The Bryophytes are represented by over 100 species, and it is certain that twice that number will be found when the collectors are more numerous and alert. Catharine a crispa is one of the rarer plants that has been found. The list of lichens is far from complete, 60 species are recorded and hardly a rock lichen collected. The number of species of fungi is 250, also a new field. The best known of the lower cryptogams are the marine algæ, they having been studied from the time of Professor Bailey to the present. Bostrychia rivularis, Callithamnion dietziae, which Professor Farlow, from a study of the original specimens in the herbarium of the Long Island Historical Society, is disposed to regard as a var. laxa of C. Baileyi, Callithamnion tenue are a few of those interesting algæ that are more or less uncommon. The diatoms are represented by a list of 78 species, which, with 45 species of fresh-water algæ, completes the numerical enumeration of the island's flora. Figures, however, are totally inadequate to express the characteristics of the flora of any region, however sparse it may be in vegetation, and it is hoped that in the near future a flora of Long Island will be in sufficiently advanced condition to warrant its publication, at least the portion recording the distribution of the phænogamous plants.

CONSUMPTION AMONG THE COLORED PEOPLE OF THE SOUTHERN STATES.

BY G. W. HUBBARD, M.D., NASHVILLE, TENN.

PROBABLY no greater change in the social condition of a people can be imagined than the transformation of a race from the state of slavery to that of freedom.

The colored people of the late slave-holding States have now been free for twenty-eight years; and their present condition in regard to health and mortality, as compared with that which prevailed before their emancipation, is an interesting question, not only to the physician, but also to the philanthropist and the student of social science.

It is almost, if not quite, impossible to obtain reliable vital statistics concerning the people of the Southern States outside the larger cities and towns; and it is only within a few years that even these have been complete and reliable.

In this article I shall consider only one disease, phthisis pulmonalis; but it may be well to remark that the general death-rate among the colored people in the southern cities, where statistics are attainable, is nearly twice as great as that among the whites.

I have made careful inquiries of many physicians who practised in the South before the late civil war, and it has been their universal testimony that pulmonary consumption was a comparatively rare disease among the slave population, some even affirming that it was entirely unknown. It would probably be safe to say that this disease was very much less frequent among the negroes than among the white people.

The prevalence of this disease at the present time will be seen from the statistics taken from the health reports of the following southern cities. The figures given represent the per cent of deaths from consumption, as compared with the total mortality from all causes; and also the proportion in 1,000 per annum.

	Proportion to Total Mortality.		Proportion in 1,000.	
	White.	Colored.	White.	Colored.
	Per cent.	Per cent.	Per cent.	Per cent.
Atlanta, Ga., 1892	9	18	1.7	7.7
Baltimore, Md.	9	15	2	4.8
Charleston, S.C., 1892	8	13	1.2	4.9
Memphis, Tenn.	10	21	1.8	5.8
Nashville, Tenn.	11	21	1.5	5.1
St. Louis, Mo., 1890	9	18	Average 1.6	Average 5.6
Norfolk, Va., March, April, and May, 1893	16	17		
Twenty-five towns in North Carolina, Feb., 1893	8	22		

It will be seen from the above table that the rate of mortality in proportion to 1,000 of population per annum is nearly four times as great among the colored people as among the white. It is probable, however, that consumption is much less prevalent in the country districts.

I will now consider some of the causes that have probably produced this excessive death-rate from this disease.

1. Unhealthy dwellings, often situated on narrow alleys, reeking in filth and moral and physical pollution. 2. Improper food, often of poor quality and lacking in quantity. 3. Insufficient clothing and exposure in inclement weather. 4. Irregular habits and a lack of a proper amount of sleep. 5. Excessive use of alcoholic drink. 6. Ignorance concerning the laws of health. 7. Lack of medical attention and good nursing.

LETTERS TO THE EDITOR.

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

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

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

Variation and Evolution.

No branch of the study of natural history is more interesting, or more likely to lead to valuable results, than that of the causes of the large amount of variation which is exhibited by many species of animals.

If, as seems certain, what were at first varieties, in the process of time, by increase of the differential characteristics, or simply by these becoming permanent, originated new species, we are, while studying the causes which favor these variations, at the same time gaining an insight into those of the origin of species themselves.

No class of animals offers more favorable conditions for this study than the terrestrial and fresh-water mollusca. The great variety of conditions under which many species live, and the numerous varieties into which they are divided, together with the ease with which they may be collected and kept under observation, make them peculiarly suitable for our purpose.

Darwin says in an extract from one of his letters which I have lately seen: "In my opinion, the greatest error I have committed has been in not allowing sufficient weight to the direct action of environment, independently of natural selection." Probably those changes which are commenced in a species by the influence of environment are, in process of time, fixed by means of natural selection. That there is a preference exhibited for individuals of a like variety, even where the variation cannot be supposed to confer any benefit, may be proved by anyone who will observe the pairing of that most variable species, both in color and banding, *Helix nemoralis*, he will find, though with many exceptions, that among the pairs which he may discover by the roadside, soon after sunrise or in the evenings during spring and early summer, that there is a decided preference shown by these animals for individuals similar to themselves, the red varieties prefer to mate with those of their own color, as do the yellows; while, in a less degree, it will be found that the many-banded select mates among their own class rather than from the one-banded or unicolorous forms.

That in the majority of instances, at least, the progeny in those cases in which individuals of a similar variety have mated resemble the parents I have been enabled to prove by selective breeding. I am still continuing these experiments, and hope to have something further to say on the subject at a future time. Doubtless other species show preferences of this kind. I have referred, however, to those of which I have most experience. Is it not probable that *Helix hortensis* and *H. nemoralis* have been derived from a common form in comparatively recent times through varietal differences which have at last become specific?

Malacologists in America have opportunities denied to us in the old country. They have the great advantage of being able to study the variations, in introduced species, which have been produced as the consequences of that introduction.

As species introduced into a new country, under different climatic conditions to those under which they have previously lived, are in some degree similarly circumstanced to species living through climatic changes produced by alterations of land and water surfaces, etc., during the changes which all parts of the world have undergone during the long geological ages, we have in their cases a means of studying what changes certain conditions are able to produce, and consequently of gaining an insight into the causes which have helped to the development of our present fauna from their remote ancestors of the past. We can study the effects of a more equable climate in some parts, of greater heat or cold in others, of more and less moisture, of changes in the food-plants, of exposure to the attacks of new enemies, etc

The more this subject is investigated, the more, I believe, will become apparent the fact that all species possess latent powers which the proper stimulus in the shape of altered circumstances, such as those suggested, is capable of bringing into action for the benefit of themselves and their descendants.

The observations at present recorded relating to the causes of variation are scattered through a large number of publications, these, in a short series of articles for another journal, I have endeavored to bring together and arrange for reference. Some of the causes which the various writers have assigned as probably inducing variation may be mentioned. Deficiency of lime in the soil produces thin, horny shells, and in some degree may cause change in their shape. Moisture, when deficient, is supposed to favor the formation of thick, white shells among the terrestrial mollusca, while its extreme abundance prevents the formation of colored bands in those species usually possessing them. Deficiency of light (as in dense forests) has been referred to as the cause of dull, unicolorous shells, while those more exposed to its influence are often gaily colored. Heat, combined with moisture, is considered conducive to brilliant coloring, with dryness as increasing the influence of the latter, while among the fresh-water species it tends to the production of fragile, dwarfed shells, overcrowding among the latter having a nearly similar effect. Dense vegetation, impeding the progress of aquatic species, has been considered a cause of scalariform varieties. Flowing and stagnant water are well known to effect the *Limnacidæ* to a large extent. Muddy, rocky, and sandy bottoms also have their effects. Food is undoubtedly an element of great importance in the manufacture of varieties in its relative abundance and luxuriance, while other circumstances have been observed where certain plants existed in unusual abundance. The presence of certain molluscan enemies has been found coincident with peculiar deformities, e.g., that of *Hydra viridis*, with deformed examples of a species of

Limnæa. Again, Mr. W. Doherty, writing from Cincinnati, records a remarkable dentate variety of *Conulus fulvus;* he further remarks that dentate species of *Helix* are the forms there prevalent, and points out that this formation is useful in obstructing the entrance of a grub which lives in beds of leaves and preys on small snails.

An American malacologist, Professor Wetherby, adduces evidence which goes far to prove that even malformations resulting from individual injuries may, under certain circumstances, be transmitted to the offspring.

In investigating these phenomena and their causes, I would suggest, first, that the manner of variation should be investigated and described, and, second, the exact nature of the surroundings as regards possible causes, always bearing in mind the conditions under which the species lives in its original home, and especially noting all deviations from these which may be supposed to induce the varietal character.

Among the species common to North America and Britain are the following: *Vertigo alpestris, V. edentula, Conulus fulvus, Helix aspersa, H. hortensis Limnæa peregra, L. auricularia, L. stagnalis, L. palustris, L. truncatula, Physa fontinalis, Bullinus hypnorum, Planorbis albus* (= *P. hirsutus*, Gould), *P. glaber* (= *P. parvus*, Say).

W. A. GAIN.

Tuxford, Newark, England.

Books for Children.

IN answer to Mr. Waldo's request printed under the above heading in your issue of *Science* for June 16, let me suggest that such books as he desires are a desideratum not only for children, but for adults who, while not scientifically inclined, are yet interested in the wonders and beauties of nature. Unfortunately our attention has been too exclusively absorbed with the struggles and the problems incident to a new country for us to have time to educate the men who could study and name all our plants and animals, much less those who could translate scientific monographs into popular language. Especially in the insect world a good collector could bring in from any summer-day's excursion dozens of specimens which have never yet been christened.

But while we cannot hope for books which will enable us to attach names to everything we may find in a ramble through Nature's museum, most of the more conspicuous animals and plants have been studied, at least enough for this purpose, though the results have been put forth in scientific works. But on the stores of knowledge thus accumulated popular writers are beginning to draw to meet the demand created by our growing out-of-door life, our increased out-of-door interests. As was to be expected, plants have received the greater amount of attention. Mrs. William Starr Dana's "How to Know the Wild Flowers," just published by Charles Scribner's Sons, at $1.50, is intended to teach one to identify the commoner flowers by color, size and shape of leaf, size of plant and so forth. Ten-year-old children would seem to me rather young to use such a book, but it is admirable for those of twelve or thirteen. Newhall's "Trees of Northeastern United States," published by G. P. Putnam's Sons, at $2, teaches one to identify trees by the leaves, bark, and so forth. This I know from experience to be admirable for children. The same author is at work on a similar book upon shrubs, but I believe it is not yet out. I know of no such book on birds as the ones I have just suggested on plants. The best thing for children I believe to be Florence Merriam's "Birds through an Opera Glass," published by Houghton, Mifflin & Co., at 75 cents. The appendix to this little book contains lists giving form, color, size, habits, song, flight, nest, and so forth of our common birds. A fuller and altogether admirable book on birds is Minot's "Song and Game Birds of New England," published, I believe, by Casino, at $2.50 or $3. The best book on insects is one which Professor Comstock, of Cornell University, has in hand. It will probably be out now in the course of a very few months. Prepared especially for the school children of California, it is written in a manner attractive to children and will contain tables by which any insect may be traced to its proper family. Farther than this it would be hardly possible for a child to go, as the characteristics on which genera and species are founded are often so difficult of observation that the best tables which could be prepared would be only a source of perplexity and worry.

After all the best method of teaching children is that which Mr. Waldo quotes as employed by his former teacher. And there are many books which occur at once to the mind of any teacher as valuable aids to the parent who wishes to work with his child. I have not named these because I understood the request to be for books which the child could use alone. But I should be happy at some future time to extend my list if it is not done by some other person better qualified for the task.

M. A. WILLCOX,
Professor of Zoölogy, Wellesley College.

Two Queries.

AN incident of a recent personal experience may interest those of your readers who are studying the subject of mimicry. On the 21st of May last, I was botanizing with two companions in the thinly populated sand-dune region at the south end of Lake Michigan, and about forty miles east of Chicago, when the event I am about to relate occurred. I was walking rather in advance of my companions across a level area that separated two series of high dunes, when I accidently stepped upon two large snakes which were lying close together, doubtless enjoying the warm sunshine. It was a case of mutual surprise, and as the snakes, or one of them, suddenly sprang upward into unpleasant proximity to my face, I only a little less suddenly sprang backward, believing for the instant that I had encountered a rattlesnake. I soon discovered, or thought I did, that the reptiles were only fine specimens of the kind of black snake, popularly called the blue racer. One of the two had been considerably hurt by my heavy tread, and with violent contortions of his body made what haste he could to a hole about six feet distant, and disappeared in it. The other was uninjured and crawled rather leisurely away in another direction to a distance of twenty feet or more, and then lay quiet, watching our movements. Irritated by the violent start I had received, and cherishing no great love for snakes in general, I seized a club, and, while his snakeship lay broadside to me, I aimed a vigorous blow at him. I was again surprised, even more so than before, though in a different way, for with lightning rapidity the lithe reptile dodged the blow which otherwise would have struck him near the middle of the body, and instantly threw himself into a coil precisely resembling that of a rattlesnake when about to strike, and shook his erected tail with such vigor and rapidity that it was scarcely more distinctly visible than the spokes of a bicycle wheel when propelled by a fast rider. At the same time a sound was emitted, less shrill perhaps, but continuous and distinctly similar to that produced by the rattlesnake. Whether the sound was produced by the very rapid vibration of the tail, assisted perhaps by its scaly covering, or whether it was a hiss produced in the ordinary manner, I am of course unable to say. So close was the mimicry that I was for the moment almost deceived into the belief that I had mistaken a rattlesnake for a racer. The illusion was soon dispelled however, for a stick which I threw at him hit him on the head and stunned him, and I then had the opportunity to scrutinize him closely and verify my first conclusion.

I have frequently heard of other constrictor snakes mimicking venomous ones, in fact have occasionally observed such mimicry myself, but never before in this species and never in such perfection. It would be interesting to know if others have observed the habit in this species.

On the same trip another fact of interest came under our observation. The region visited contains many ponds and lagoons, and in these turtles (mainly *Chrysemys picta*, Ag. and *Nanemys guttatus*, Ag.) abound. About these ponds, often many rods from the water, were the remains of hundreds of turtles that had evidently all been killed since the opening of the spring, and some of them within a few hours. The dead turtles varied in size from those with carapaces two inches long to those fully six inches in length. It was clear from an inspection of those most recently killed, that they had been killed by some animal for food. The flesh of all had at least been partly devoured, but it was observed that not a carapace nor a plastron was broken. The reptiles had been killed, apparently, by some sharp-beaked bird, by thrusting its beak between the joints of the reptile's armor, so to speak. The loon is clearly competent to do this, but loons are seldom seen in this locality. Moreover these birds would hardly drag their prey so far inland to devour it, as was observed to be the case with many of the turtles. The blue heron is more abundant here than the loon, but still not abundant enough to be credited with so much destructive work on animals so large. I have never suspected him, either, of being a turtle-eater. The only other birds competent to do the work and sufficiently numerous and intelligent to be suspected, are crows. Several flocks of these were hovering about the locality, and though we were not able to approach the wary birds close enough to observe them feeding, our suspicions fell upon them. Has any reader of *Science* observed crows killing turtles? If so, is this a well established habit of the bird or is it one which has been recently acquired?

EDSON S BASTIN.

Chicago, Ill., 2421 Dearborn Street, June 14.

The Aurora.

DR. VEEDER'S reply of June 2nd, is so objectionable on account of the positive way in which he closes his part of the argument (believing, as I do, that his facts are in fault) leaving it to be believed that at "no point throughout the research has there appeared to be even the slightest 'chance' for an alternative hypothesis," that I am once more tempted to reply. Let me, before passing on, emphasize the fact that we are not discussing the question of "magnetic storms" and sun-spots. I believe there is only one astronomer and physicist of any eminence who disbelieves in this association, so that as far as discussion of the question is concerned, we may consider it as practically closed; but, even if I held the contrary opinion with the majority, so long as an opponent of such eminence held out, I should consider it inadvisable to be as positive as Dr. Veeder in his last letter, on the subject of the aurora, where, I believe, I am not alone in supposing there is reason to doubt a connection between this display and areas of disturbance on the eastern limb of the sun. I have raised some well-known objections to this theory, and, as a rule, have been met by Dr. Veeder with generalities (*Science*, April 7, 28, May 19 and June 2); it is unnecessary to mention them again here, so that I shall content myself with discussing this last contribution, which leaves me in such an uncomfortable position, apparently.

The whole base and superstructure of this theory is erected upon a solar period of rotation of "27¼ days," and to quote from a letter which I have received from Dr. Veeder, dated March 16, 1892, the addition of "a few hours difference in the length of the period introduces a drift into the tables that becomes everywhere apparent" Surely this is a suspicious degree of perfection in the theory, as no one knows what the solar period of rotation is: such periods as have been determined from sun-spots (the only possible method so far) give values between 25 and 27½ days, depending on the solar latitude of the spot; yet, the addition of a "few hours" can introduce a "drift which becomes everywhere apparent," when 2½ days is left out of the tabulating without apparent effect, for, it is evident, that in considering the effects of the return to the eastern limb of a sun-spot or area of disturbance, that it is not a fixed rotational period that should be used, but the one belonging to the latitude of the spot under discussion.

This year auroras were visible here on the following days of the year: the 5th, 6th, 8th, 21st, 35th, 36th, 44th, 45th, 46th, 47th, 104th, 109th, 127th, 128th, 130th, 144th, 145th, 160th, 164th, 165th and 166th. If auroras are caused by a disturbed solar area at the eastern limb, we should find, by adding the interval adopted by Dr. Veeder of 27¼ days to any of the above days, the probable date of the returning display. What do we find in fact? That, of the 52 periods obtained by adding this interval in succession to the above days, up to the present date, there were only 10 of the days so determined on which displays took place; that is, 20 per cent of successes as against 80 per cent of failures. In illustration of the above, the aurora of the 5th day should have reappeared on the 32¼, 59½, 86¾, 114 and 141¼; from the days of auroras given above, it will be seen it appeared on none of the required dates; nor did that of the 6th; that of the 8th reappeared twice out of five solar periods; the 21st, once out of five; the 35th, once out of four, and so on.

One more objection, previously overlooked, before passing on. I am of opinion (no one can be certain, failing the necessary observations), that there is practically no instance in which aurora displays are not taking place in one hemisphere or other of the earth; a large proportion should be observed co-incident with any other class of recurrent phenomena, and think it possible that "chance," which Dr. Veeder avoids the discussion of, is really an important element in our discussion, as I shall now endeavor to prove this by his own admissions.

In a letter to me, dated May 4, 1892, he says: "The year 1879, selected for printing as an illustration of the results seen throughout the entire table, is one of profound minimum at which times solar disturbances are well separated from each other and the relation *comes out distinctly* although for the construction of such a table one year is just as good as another." (*italics* are mine.) This is a perfectly sound conclusion, and by it alone might this theory stand or fall if "chance" is not, or is, as important as I maintain. On May 13th, Dr. Veeder writes: (This table of comparison between the phenomena being now printed) "It [1879] being a year of minimum the relation *does not come out so strongly as when disturbances were more numerous*. In the next year (1880) *the numbers would be much larger and the relation in every way more distinct.*

So far, then, Dr. Veeder has been about equally positive on *both* sides of this question, both of which opinions are apparently obtained from the observations he is in possession of, leaving the possibility open (it is his suggestion) that we are very far from "a realizing sense, that it is *facts* and not a personality against which" we "are contending."

Might I again suggest the advisability of setting a limit on the term "eastern limb," adhering *rigidly* to it throughout the investigation, not admitting too much of the suppositional when sun-spots fail at the required period by the substitution of "faculae," and seeing how far the element of "chance" enters into this question by showing a continuous series of comparisons through a semi-period, at least, of solar activity.

W. A. ASHE.

Quebec, May 17.

Scientific Words in the Century Dictionary.

ALTHOUGH one of the most useful books published, the Century Dictionary is, of course, not faultless. The mention of a mistake in a recent issue of *The Critic* reminded me also of the following:—

According to the latest edition of Foster's "Physiology," saliva "in a healthy subject is *alkaline*, especially when the secretion is abundant. When the saliva is scanty, or when the subject suffers from dyspepsia, the reaction of the mouth may be *acid*." According to the Century Dictionary, the saliva "is a colorless ropy liquid which normally has an acid reaction."

The word "griffe," which is commonly used in Louisiana, is defined by the Century Dictionary as a "a mulatto—especially a mulatto woman." I have copied in a note-book from a lecture delivered in New Orleans by Hon. Charles Gayarré, the historian of Louisiana and authority on such matters, the following:—

"In Creole America there is a very mixed population Even in very early times there were these distinctions: European, or fresh white immigrant; Creole, or pure white American of European parentage; the aboriginal Indian; the *griffe, or cross between Indian and negro*; the mestizo, or mixed white and Indian; the mulatto, etc., etc." These may not be the exact words of the speaker, since I may have misunderstood or copied it wrongly, but I think the same statement may be found in one of his works. Griffe, no doubt, is from the Spanish *grifos*, meaning frizzled hair. This is a peculiarity of many of the crosses between Indian and African. I need but mention the Cafusos, who, according to Tyler, "are remarkable for their hair, which rises in a curly mass, forming a natural periwig, which obliges the wearers to stoop low in passing through their hut doors."

The word *playa* is not mentioned in the Century Dictionary, although, according to the *Popular Science Monthly*, vol xxii., p. 381, it "has been adopted by geologists as a generic term, under which the various desiccated lake-basins of the West may be grouped."

Although the *œse*, or *platinum-needle* or *loop*, is the most important tool of the bacteriologist, both of these words have been omitted. The word *œse* is, of course, German, but is now much used in English books.

The common names, and often the scientific names, of well-known plants have been omitted. The *Amorphophallus titanum*, a vegetable wonder of the Arum family, discovered in Sumatra in 1878 by Beccari, is not mentioned under its generic or common East Indian name of *Krubut*, although both of these appear under *Rufflesia*, the generic name of a remarkable plant which grows with it.

The word noctilucent is defined in the Century Dictionary, but the word noctilucence, a term sometimes applied to the light emitted by the *Noctiluca*, is omitted, although phosphorescence is the more common, but perhaps less accurate, term.

Many of the definitions are inaccurate and unsatisfactory. From the following definition of Carib, one would conclude that they are all of a "native race" and that none are living in the Caribbean Islands at the present time: "One of a *native race* inhabiting certain portions of Central America and the north of South America, and *formerly* also the Caribbean Islands." According to the latest Handbook, in British Honduras, there are 2,200 Caribs who, "although to all appearance of true African origin, being a black and woolly-headed people, are a mixed race of the aboriginal Caribs, with a large percentage of African blood." A few true Red Caribs and some Black Caribs still live in the Windward Islands. The true Caribs are not natives of Central America. They inhabited the northern part of South America and the Caribbean Islands, and, according to Dr. Brinton, their original home was south of the Amazon. JOHN GIFFORD.

Swarthmore College, Pa.

A Peculiar Occurrence of Beeswax.

In *Science* for June 16, 1893, Mr. George C. Merrill, of the U. S. National Museum, has a request for information under the above heading concerning some beeswax forwarded to him from Portland, Oregon. He describes it as having all the elements and characteristics of beeswax, but says, "such it would have unhesitatingly been pronounced but for certain stated conditions relating to its mode of occurrence."

He says it occurs in the sand along the beach, at quite a depth in places, and in a fragment of sandstone, etc., and further says: "Tradition has it that many hundred years ago a foreign vessel (some say a Chinese junk) laden with wax was wrecked off this coast. This at first thought seems plausible, but aside from the difficulty of accounting for the presence in these waters and at that date of a vessel loaded with wax, it seems scarcely credible that the material could have been brought in a single cargo in such quantities nor buried so deeply over so large an area."

The first difficulty Mr. Merrill seems to encounter is the presence of a vessel of that supposed nation on our coast at so early a date. This should give him no difficulty whatever, for Hon. Horace Davis, of California, in an article before the American Antiquarian Society, April, 1892; Charles Walcott Brooks before the California Academy of Sciences, March 1, 1875, and Professor George Davidson, of the U. S. Coast Survey, for thirty years or more last past, have all been calling attention to the hundreds of known wrecks of Japanese (not Chinese) junks cast on the American shores, from Behring Sea to Peru, by the "Kuro Shiwo," or black stream of Japan.

In both the articles mentioned above you will find an account of the "beeswax junk" and so much information concerning it that Mr. Merrill's doubts will be dissipated; if not, Professor Davidson, in the "Coast Pilot of California, Oregon and Washington Territory," 1869, describes this very junk and the very beeswax in question.

Mr. Merrill's informant, however, seems to have fallen into an error as to the quantity and locality of this wax; for no such quantities were ever found as those mentioned in *Science;* in fact, the story is this: At some recent—but prehistoric—time a Japanese junk loaded with beeswax was thrown ashore at or near Clatsop beach, Oregon, and the cargo was scattered along the sands and buried therein, where it is found even to-day in small quantities and that is all.

Mr. Merrill's letter to *Science* is published, he says, "in the hope of gaining more information on the subject," and I will be fully repaid if through the instrumentality of this note he shall have obtained that information.

Many Japanese wrecks have been thrown ashore on our coast, of which we have authentic information, all the proof of which has largely been collected by the eminent gentlemen quoted above.

JAMES WICKERSHAM.

Tacoma, Washington, June 26.

Color Perception: A Correction.

I HASTEN to send this note of correction to my paper on "Distance and Color Perception by Infants" in *Science*, April 28 — an error brought to my attention by a friend. In Tables I. and II. of that article (p. 231) I have taken the proportion of "acceptances" to the entire number of cases $\left(\text{the ratio } \frac{A}{N}\right)$ after adding up the simple numbers for each color at all the distances. It is evident that the resulting percentages are wrong as representing comparative results for the different colors, since there are not an equal number of cases for each same color at different distances, nor for the different colors at each same distance. The proper method is, of course, to compound the percentages representing the relative attractiveness of each color at each distance. This gives the values $\left(\text{for } \frac{A}{N}\right)$ in Table I.: Blue, .78; red, .75; white, .78; green, .68; brown, .43; and in Table II.: Newspaper, .76; color, .71. This brings white up to the level of blue and red. The same correction should be made for the values $\frac{R}{n}$, but in the result it is immaterial.

I wish to add, also, that I do not consider the results relative to the individual colors of much value, since the cases are so few. The experiments had to be broken off unexpectedly. I published the tables mainly to illustrate the working of the method of experimenting. For this reason I did not enter in my article into side considerations, such as color-brightness, fatigue, etc., which were duly provided for in the experiments themselves. I hope to discuss such points in the fuller treatment of the monograph on the infant's active life which I am preparing.

J. MARK BALDWIN.

Princeton, N.J., June 30.

Birds that Sing in the Night.

I have read with a great deal of interest the notes under this head as they have appeared in *Science* from time to time. While some species have been mentioned that I have not heard, there are also some not mentioned which are night singers in central Iowa, where I have spent many years studying the birds in their various moods and conditions.

The first in point of beauty of execution is the wood-thrush (*Turdus mustelinus*). Not only does he sing in the night, but his song is given at shorter intervals and more earnestly then than during the day. It is rarely that he sings at high noon, unless the day be dark and wet. Nor does he sing all night long; from midnight until after two, there is only an occasional burst of song or none at all.

Second in point of regularity and persistence is dickcissel (*Spiya americana*). Not only does he sing at short intervals all day long, but he prolongs his day far into the night. By day his song is not very musical, but at night it seems softened and subdued almost to sweetness. The country boys call him the "sheep-sheep shear-shear-shear" bird, as an imitation of his song. The first two notes are uttered sharply with a considerable pause between them then, the last very rapidly — nearly run together.

Two other birds are not uncommon night singers — the grasshopper and henslow's sparrows (*Ammodramus s. passerinus* and *A. henslowi*), especially the latter. His modest little song is so drowned out during the day by the larger birds that he must sing at night it he be heard at all. I have often heard his note well into the night.

There is one winter night singer, the chestnut-colored longspin (*Calcarius ornatus*). As one wanders over the snow-clad hills on some frosty night, he may near the clear *chee-llo* of this bird starting from the snow where he lies hidden.

LYNDS JONES.

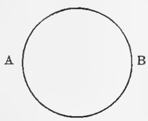
Oberlin, Ohio.

The Earth as a Conductor.

In reference to the communication on the use of the ground in an electric circuit, June 16, you may allow me to say: The earth is not a conductor of electricity in any sense, only as a convention. All Du Moncel's measurements, and they were many, gave the resistance of the earth as about 100 ohms. This resistance is negligible in long circuits, telegraphic or telephonic, but not in short circuits.

On the principle of contact electricity (see Ayrton and Perry, Jenkins or Gorden) it was wrong to place a copper plate at one end and a tin plate at the other, as their contact or connection by wire would produce a current along the wire. Nor was it proper to put charcoal or carbon or iron around either plate on the same principle. Both plates, preferably, should be of copper surrounded by sulphate of copper. There is considerable resistance offered in the passage of a current from one kind of material to another (see Jenkin passim).

The earth may, for convenience, be called a reservoir of electricity, but its quantity is always constant and no electricity can be taken from it at one point without putting an equal quantity into it at another point. The action or roll of the earth in the circuit is like this. Consider a lake of large dimensions with a



lift and force pump at A connected with a pipe which crosses the lake to B; the water lifted at A and forced over to B falls into the lake, but not a drop of it ever gets back to A.

If you will consider a ground wire in a large telegraph or telephone office with a number of circuits of variable resistances and different polarities attached to it you will see that it is absurd to say that a positive current from one battery goes down that ground wire and off to a distant point while at the same instant a positive current from a distant battery comes up the same wire. That is the common sense view of it, and it is supported by Kirchoff's law, $\Sigma C = 0$, or the sum of all the E M F's or currents meeting in a point equals nothing. In fact, the ground wire in a large office may be cut (as I have often seen it done for experimental proof) without stopping communication. When three or more wires are joined to the same ground either one of the wires acts as a return wire for the others when the ground wire is cut. But when all are open at once, then the ground comes into play to form the circuit for the first one that closes. It is also useful as a regulator of current, but the manner of doing this is not properly introduceable here.

If nothing had been said of the use of tin at one end and copper at the other the resistance of 102 ohms as found would indicate a good ground. But as some current probably arose from their use, doubt is cast upon the measurements. Still, on the whole, the ground was as good as is usually made.

One hundred ohms' resistance in the earth circuit under all circumstances should be reckoned on and may be regarded as a constant.

D. FLANERY.

Memphis, Tenn., June 30.

On the Evolution of the Habit of Incubation.

IT may be stated as a general rule that harmless snakes produce their young by means of eggs, while poisonous serpents are viviparous, to which fact they probably owe their generic appelation of "vipers." The oviparous snakes, like most other reptiles, deposit their eggs in a sunny spot, and never trouble themselves about the incubation, but leave the eggs to hatch out as best they may under the influence of the sun's heat. There is, however, a very curious though authentic instance on record of a caged python, in the *Jardin des Plantes*, at Paris, which hatched out her own eggs. She laid fifteen in all, and then coiled herself around them, and so incubated them in much the same manner as a setting hen, her temperature being observed to increase perceptibly during the period.

This strange fact, whether an anomaly or whether a natural habit of the pythons, seems to throw considerable light on the evolution of the habit of incubation, so universal among birds, for it must be remembered that the bird is closely allied to the reptile, and is in fact but a higher form of the type. This relationship is clearly shown by the study of the morphology of the bird's organs, for every part of a bird's body is but a modification of the corresponding part of the reptile; it is also shown by the fact that birds are found in geological strata immediately after the reptiles, and hence must have appeared upon the face of the earth at a later period. Were any further proof necessary, it is furnished in an irrefutable manner by the science of embryology, for the bird passes in the egg through all the reptilian stages of development before it is finally hatched out in its perfect form.

This being the case, we may rest assured that the habit of incubation has been evolved at some time during the evolution of reptiles into birds, and hence this case of the python hatching its own eggs acquires exceptional interest.

We may premise that the habit could never have been evolved unless it were of some value to the species, but we must at the same time admit that the incubated egg would in all cases hatch out far in advance of that heated only by the sun, hence those individuals which thus appeared earlier than their brothers ran a better chance of surviving in the struggle for existence. So far, so good, but how did the habit originate? What first led snakes or other reptiles to think of hatching out their eggs? That it was not intelligence we can safely assert, for all who have had any experience in keeping snakes, agree in stating that their intelligence is of the lowest order. I am therefore inclined to believe that what first led animals to incubate their eggs was the heat developed in the egg during the process of hatching. Snakes are exceedingly fond of heat, in fact I have known them to injure each other in cages in the attempt to retain the warmest places. Hence we can infer that if, when basking in the sun, a snake chances to lie near its eggs, especially if these have already begun to hatch, it will soon feel their heat and so be led to coil more closely about them, and while thus warming itself it will at the same time hasten the process of incubation.

The next question that arises is, how this habit of incubating her eggs, even when thus acquired, will be transmitted to the offspring, for if not transmitted, the habit could never become general.

So little is known of the principles of inheritance that we cannot hope to solve this problem at present. Even Darwin, who made a life-long study of the subject, and to whom we are indebted for the ingenious theory of *pangenesis*, was forced to admit our abject ignorance of the laws of transmission of characters from parents to children. We can, however, infer that those serpents most susceptible to the cold would be most likely to remain by their eggs, and this susceptibility to cold would tend to be inherited by the young

Moreover, when we remember what unexplainable cases of inheritance occur, such as special movements during sleep, we must admit that even the tendency in a snake to incubate its eggs may also be transmitted, the more so as we have an indisputable inheritance of the same nature daily shown us in the case of birds, for the tendency of the parents to incubate their young is in all cases inherited by the offspring.

CLEMENT FEZANDIE.

686 Lexington Avenue, New York.

Another Ancient Argillite Quarry Near Trenton,

ON the left bank of Neshaming "Creek," Bucks County, Pennsylvania, about three-fourths of a mile above the mouth of Labaska or Mill Creek, I discovered at the base of the cliffs of metamorphosed slate that there overhang the stream, on June 23, another ancient work-shop where blocks of argillite, lying *in situ*, have been chipped into "turtle-backs."

A layer of chips, hammer-stones, and the now familiar rude leaf-shaped forms is laid bare for several hundred yards where the stream has worn away the margin. The blocks of workable stone in various instances show peckings upon their sides, as do similar specimens at Point Pleasant, inferably made by the ancient workmen to split them with the grain.

No search has yet been made for diggings and refuse-heaps higher up the slope, nor has excavation been made into the exposed layers; but thus far the story of the workings on Gaddis' Run, near Point Pleasant (Bucks County, Pennsylvania), discovered on May 22, seems to be repeated, though on a smaller scale. There we were twenty-five miles from Trenton; here we are but fifteen.

H. C. MERCER.

Do Nestlings Drink.

This question suggested itself to my mind very lately, when I observed the following, and to me, entirely new fact:

A piazza-roof, on which my windows open, is provided with a shallow gutter, in which there is a considerable accumulation of the winged seeds from a neighboring tree. These were standing in shallow water, left there by the recent rains.

I observed a robin alight on the roof, and noticed that she picked from the gutter a bunch of those seeds, which she held in her bill while she seemed to be preparing to fly away.

Presently, apparently dissatisfied with what she had picked up, she dropped the seeds, and moving to a place where they were lying in a thicker bed, she gathered a much larger mass of them, about as many as her bill would hold together. After gathering them and satisfying herself that she had enough, she deliberately dipped the mass into the water and flew away with it to a distant tree. Perhaps some of your readers may suggest a truer explanation; but to me she seemed to be carrying a supply of water to her brood in what was no inadequate substitute for a sponge.

FRANCIS PHILIP NASH.

Geneva, N. Y., June 28.

BOOK-REVIEWS.

Logarithmic Tables. By PROFESSOR G. W. JONES. Ames, Iowa, the Author.

THE title of this book does not exactly describe its contents. The strictly logarithmic tables are only about one-half of those given. The arrangement of the tables, of which there are eighteen, has been made to meet the wants of those who desire to have, in a handy form, tables to be used in computations covering a wide range. Table I. is a four-place, of numbers from 1 to 1,000, followed by one of the same accuracy giving the six principal trigonometric functions, and of the lengths of arcs in radians. The first five degrees of the quadrant are given to each five minutes, the following to each ten minutes, with differences for single minutes. A table giving the squares, cubes, square-roots, cube-roots, and reciprocals of the numbers 1, 2, 3, 99 is also given. Table III. is a six-place table of numbers, the side numbering being carried to only three figures instead of four, as is usual in

CALENDAR OF SOCIETIES.

Agassiz Scientific Society, Corvallis, Ore.

June 14.—Dr. Pernot, Aphasia.

such tables. In Table IV. will be found all of the useful constants used in mathematics, chemistry, engineering, physics, and weights and measures. This table is a very complete one, containing, as it does, reference to almost every standard and constant used in the arts and science. Table V. is a reprint of the Gaussian six-place addition-subtraction logarithms. For determining trigonometric functions, there are two tables, the four-place already mentioned, and also a six-place table. The latter is a departure from the usual method. Generally, in a six-place table, the functions are given for each ten seconds. Professor Jones has made up the table for each minute of the quadrant, the proportional part being given for each second. The tables that follow those just explained consist of prime and composite numbers, squares, cubes, square-roots, cube-roots, reciprocals, and quarter-squares. Finally, we have Bissel's table of coefficients for interpellation, and a table containing the integral for finding the mean or probable error of a result in least squares. We judge from our examination that Professor Jones has prepared the tables with great care. He seems exceedingly anxious to free them of all errors, and to induce that condition of things he offers a reward for an error found in the tables. We have not critically examined the tables, but we note a slight error in the text. On the first page the reference to the pages containing Table IX. should read 118–133 instead of 114–133. We would commend these tables to the computer as being a help to have on one's desk. G. A. H.

Pioneers of Science. BY OLIVER LODGE, F. R. S., Professor of Physics in Victoria University College, Liverpool, with Portraits and Illustrations. London, Macmillan & Co. 404 p. 8°. $2.50.

IN this work, Dr. Lodge has given the general public and the student a very interesting and readable book. As he states in his preface the book had its origin in a course of lectures on the history and progress of astronomy, delivered by the author in 1887. As is often the case with books based on a course of lectures, it is somewhat disjointed. It is full, however, of interesting matter, and is lavishly illustrated, an unusual feature in works of this class. Its title is unfortunately misleading as the author does not attempt to cover the whole growth of scientific knowledge, but confines himself to astronomy. The book, however, is unique in the endeavor by means of plain, unaffected writing and a wealth of illustration to bring the pioneers of celestial knowledge into almost personal acquaintanceship with the reader, tracing the history of their discoveries and the dependence of one discovery upon another. It is to be commended to students of the history of science as a most useful reference book, and to the genenal reader as a book at once entertaining and instructive. J. E. I.

AMONG THE PUBLISHERS.

THE career of the late Sir Richard Burton, the distinguished traveller, was most adventurous and romantic. He was an encyclopædic scholar, and much more than a scholar. He knew and had seen more of dark Africa than most men, and more of Mohammedan lands than any man. His biography, by Lady Burton, will be published shortly by D. Appleton & Co. The book will be decorated with illustrations and maps, as well as portraits. The first part of the story, it is said, will in the main be told in Sir Richard's own words.

—The weekly paper known for the last twenty-five years as *The Christian Union* with its first issue for July changes its title to *The Outlook*. It will remain unchanged in other respects, except in the line of improvement and enlargement. It will be, as before, a family paper, non-denominational in religious matters, and giving large space to the current history of our times; to literature, economics and progressive movements of all sorts, and to home life. The Rev. Dr. Lyman Abbott will remain as its editor-in-chief, with Mr. Hamilton W. Mabie as his associate, and an editorial staff of several members.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

I have a fire-proof safe, weight 1,150 pounds, which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

For exchange.—Hudson River fossils in good condition from the vicinity of Moore's Hill, Ind., also land and fresh water shells. Desire fossils and shells from other groups and localities. Address Geo. C. Hubbard, Moore's Hill, Ind.

For sale at low price.—A fine old-fashioned photographic camera, rosewood box, one foot square, lenses, four inches diameter, made by C. C. Harrison. Plateholders, troughs, baths, etc., all in large wooden case, formerly the property of the late President Moore, of Columbia College. This is a fine example of an instrument of the best make for the old wet-process methods, and valuable to any institution or amateur interested in the history of photography in the U. S. Address M. S. Daniel, 236 W. 4th St., New York.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

For exchange.—I wish to exchange Lepidoptera of South Dakota and other sections, for Lepidoptera of the world. Will purchase species of North America. Correspondence solicited, particularly with collectors in the Rocky Mountains, Pacific coast and Hudson's Bay regions. P. C. Truman, Volga, Brooking county, South Dakota.

For sale.—Wheatstone Bridge wire, made to order, new and unused. Price, $10. W. A. Kobbe, Fortress Monroe, Va.

For sale or exchange.—One latest complete edition of Watt's Dictionary of Chemistry, in fair condition; one thirty volume edition (9th) of Allen's Encyclopædia Britannica, almost new. Will sell cheap for cash or will exchange for physical or chemical apparatus. Address Prof. W. S. Leavenworth, Ripon College, Ripon, Wis.

Exchange.—One celestial, one terrestrial globe, one lunatettis and charts, celestial maps, diagrams and ephemeris from 1830 to 1893, astronomical works, all in good condition. Will sell cheap or exchange. Make offer. C. H. Van Dorn, 79 Nassau St., New York.

Wants.

A GRADUATE of an American Polytechnic institution and of a German university (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St., Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

A ZOOLOGICAL collector and taxidermist of ten years' experience in the field is now open to engagement, for either field or laboratory work. References furnished. Address Taxidermist, Box 75, White Sulphur Springs, West Va.

WANTED.—A set of Allen's Commercial Organic Analysis, 4 vols. Vols. I. and II. particularly desired. Condition not important, all leaves being present and in place. Address Charles Platt, 34 Lewis Block, Buffalo.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y.

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi, cyrtonyx montezumae, dendragapus franklini, lagopus welchi, tympanuchus cupido* and *pedioecetes phasianellus.* Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3922 Fifth Avenue, Pittsburgh, Pa.

SCIENCE

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SCIENCE

NEW YORK, JULY 14, 1893.

THE WRENS OF TRAVIS COUNTY, TEXAS.

BY CHARLES D. OLDRIGHT, AUSTIN, TEXAS.

1. *Catherpes Mexicanus conspersus*, Cañon Wren. This bird is an "endemic" species, its occurrence in any district depending on the topographic features. The great rock walls of the Colorado River, and the numerous side cañons form an ideal dwelling-place for this little bird, and here it may be found at all seasons, and its loud, ringing song re-echoes from cliff to cliff in the dreary days of November as well as in April's sunshine. But it penetrates into the city, and every morning this year one of the first sounds that I have heard has been the matutinal song of a cañon wren whose nest was in a cranny of an unoccupied house standing next to mine.

The cañon wren (as active a busy-body as the rest of his tribe) seems to be never too tired to sing. Reclining on the soft grass at the margin of the rivulet you look up the great frowning cliff and see a tiny bird, now clinging to the perpendicular rock, now disappearing in some crevice of the cliff and then perching on a projecting fragment, he utters a succession of clear bell-like notes in a descending scale

As this wren usually nests in some crevice far up in the cañon wall its eggs are often safe from the hands of the oölogist. Many times have I gazed longingly at a few straws projecting from a hole, while the owner of the nest watched me complacently. In such cases "'tis distance lends enchantment to the view." However, I have had the pleasure of examining several nests containing eggs and young, and as I have never seen any detailed account of the nidefication of this species, I will give some particulars about them.

This bird begins building early in the season, a nest with hatching eggs in it having been taken on the 30th day of March. In 1890 fresh eggs were found April 3, 4 and 11.

The nest is placed in some cranny or hole of convenient size, always in the face of the cliff; other situations are on a rafter in a barn, under the cornice on a veranda and in the chimney of an uninhabited house.

The nest is composed of grass and weeds and lined warmly with hair, wool and cotton. The complement of eggs varies from three to five, four being perhaps more usual than either of the other numbers.

The eggs always have a clear white ground, while the markings vary from a very slight sprinkling of brown pin-points to numerous large blotches and spots of reddish-brown and lilac, forming a confluent ring encircling the crown; this is the most common pattern of coloration. Their shape is ovate or rounded ovate, but I have seen one pyriform egg in the nest with three other normally shaped eggs.

2. *Phryathorus ludovicianus*, Carolina Wren. An abundant bird in the bottom lands along brooks and in all heavily timbered country. The Carolina wren is another fine singer, but spends too much of its time in scolding owls, crows and men. But often, especially in the spring and at sunset on a summer's day, one of these birds will perch on the topmost twig of a tall shrub and will, with his tail drooping and head thrown back, call "sweet William" until the woods resound. By the way, "sweet William" does not express the exact sound of the bird's notes to me, but I am so hopeless of expressing birds' voices by English words that I will not attempt to amend it.

This bird cannot be called particular in its choice of a nesting-place, for their nests have been found in hollow logs, under the cornice of a house, in a tin can placed in a tree, in a hole in a rock wall and on the window sill of a farmhouse. The hollow log is, I believe, the most usual situation. The nest is made to fit the cranny in which it is built and generally fills it. Twigs, grass weeds, leaves, hair, cotton, wool, rags, paper and even other materials enter into its composition. In shape it is more or less rounded, with an entrance in the side. The eggs are four, five or six in number, five being most common.

There is not much variation in the eggs; the markings being in some heavier than in others. The ground color is white, spotted thickly and finely with specks of reddish-salmon color and lilac, generally forming a poorly defined ring around the crown. The ground color is usually well concealed.

Fresh eggs may be found from April 1 to May 15, the height of the breeding season being during the middle of April.

3. *Thryothorus bewickii murinus*, Baird's Wren.

Probably our commonest wren, found in all kinds of country, bottoms or uplands, forest or prairies, mountains or plains. I believe, however, that Baird's wren prefers a broken country, little patches of prairie and mesquite groves alternating with the timber.

A number of these birds must spend their whole lives in the city of Austin, for in nearly every garden one may find a pair.

They are fussy little creatures hardly ever silent for a moment but keeping up a lively chatter or querulous "chee, chee, chee." But all through the spring, even as early as January, the males are great singers, and early on an April morning one cannot go far without hearing the sweet and cheerful song of one of these little birds. At such times one finds the bird perched in a tree-top, but on other occasions he will be hopping amongst the bushes or along a rail fence. flirting his long tail, uttering a continuous "chirp, chirp," and at each third "chirp" stopping a moment to pour forth his little ditty. This is kept up for hours at a time.

In February the wrens become restless and may be seen promenading the back yards in pairs peering into every hole and bird-box. They seem to be often undecided as to a nesting place, for I have known of a pair starting four different nests within a week, without any apparent cause for their fickleness. Any place seems good enough for this bird to start a nest—though as I have just stated they are more particular about its final location. Many people here have put small wooden boxes at their gates for the reception of mail matter, and I verily believe that each one is looked into once a year by a Baird's wren, with a view to building in it, and indeed many are chosen as nesting sites.

The nest is simply a mass of rubbish—but always warmly and softly lined with feathers or cotton. Six is a common complement of eggs, but as many as eight or as few as four may constitute a full set. The eggs are white, more or less speckled with brown of varying shades and lilac, sometimes the specks of reddish brown are thickly and uniformly distributed, again they are collected into a ring surrounding the crown or else rather larger specks of chocolate brown and lilac shell markings are more sparingly disposed.

Two "albino" eggs came under my notice last spring; one was immaculate white, the other had a very faint speckling on the crown; both these eggs were with other normally colored eggs. I also found a peculiar "runt" egg of this species, it is of normal coloration but measures only .55 by .44, being thus the size of a humming-bird's egg. I found it one day in a hole in a telephone pole, and left it thinking that more eggs might be laid, as I saw the birds at hand; but when, after the lapse of several days, none were deposited, I took it. Why the bird laid no more I do not know. Surprise at the first one may have had something to do with it.

4. *Troglodytes aëdon aztecus*, Western House Wren.

Of this member of the family I can say but little, for during his winter stay with us he is very silent and indeed shy.

I am aware that he, like his kinsmen, can scold with remarkable vehemence, for I have heard him. While he remains with us he is to be found in the creek bottoms wherever there are thickets of brush-wood. He remains with us until late in the spring, indeed the other wrens have young ones before he thinks of leaving for his northern "summering place." Last year I saw some on the 22nd of April. I sent one of them to Washington where the "bird doctors" pronounced it "aztecus."

5 *Salpinctes obsoletus*, Rock Wren.

This bird hardly deserves a place to itself, being quite uncommon and differing little in appearance and mode of life from the Cañon wren, which seems to represent it with us. It is more common further west. Indeed, this is the most easterly record in Texas of its occurrence.

METALLIC CARBIDES.

BY F. P. VENABLE, CHAPLE HILL, N. C.

THIS name is given to compounds formed by the direct union of carbon with the metals. They are not numerous nor do they seem to be easy of formation and it is very difficult to prepare them in a pure and definite form. Consequently they have been but little studied so far. None of them are known to occur in minerals of terrestrial origin.

Interest in these bodies has been heightened of late by the discovery of new ones, and by the instructive decompositions of some of them.

First as to the general mode of formation. They are usually formed by the action of intense heat upon the metal in the presence of carbon. The form of this carbon is capable of being greatly varied. Graphite, amorphous carbon and many hydrocarbons can be used. The carbide is especially formed when the metal is being extracted from its compounds, that is, in the nascent state. Several metals thus unite with carbon in the process of manufacture, as zinc, copper and notably iron, and the presence of the carbides renders the metal hard and brittle. The purification and analysis of these bodies is not at all an easy problem, and hence little or nothing is known of their formulas or chemical constitution Five or more formulas have been assigned to iron carbide, and, of course, several may exist, still the correctness of any of these formulas is questionable.

The heat of the ordinary furnace is sufficient to form the carbides of the metals already mentioned. For others, more recently discovered, as the carbides of aluminium, of calcium, of barium, etc., the intense heat of the electric furnace is necessary. The first of these, aluminium carbide, is a most interesting body, of a light golden yellow color, it can be gotten from the electric furnace in a mass of corundum and metallic aluminium. It was described first by Sterry Hunt. Though it will stand intense heat in the air without appreciable change, yet really it is undergoing change all the time as is proved by the odor of hydrocarbons coming from it and the fact that left to itself in air it crumbles in a few weeks into a mass of white alumina. A few shining golden scales of the pure substance can be separated, but so far no analysis has been given to the world.

All of these carbides, under certain conditions, give off their carbon in the form of hydrocarbons. The same smell can be detected in all during their decomposition. In some cases, as iron and zinc, the decomposition is caused by the action of an acid. The carbides of the earths decompose in moist air and more rapidly in water. Calcium carbide decomposes the most energetically of them all. The evolution of the hydrocarbons would be called violent. Of course, the hydrogen needed for the reaction comes from the decomposition of the water or from the hydrogen acid.

A most interesting fact recently published in the scientific journals, is that the calcium carbide on decomposition yields lime and pure acetylen gas. The acetylen seems very pure. A thousand cu. cm. of the evolved gas was passed into an ammoniacal solution of copper chloride and not a bubble went through. All was absorbed and precipitated. This is very important because the modes of preparing acetylen in common use are tedious or expensive, and hence this important hydrocarbon has not been as carefully studied as it otherwise might have been.

The formation of hydrocarbons by the decomposition of iron carbide has furnished a basis for one of the theories as to the origin of petroleum. If great quantities of iron carbide existed beneath the earth's surface and were subjected to decomposing influences, such oils and gases as are found in petroleum regions might very easily be formed.

So far there has been little utilization of these carbides commercially. One of the purer forms of iron carbide is used in a process for preparing metallic sodium, and the iron carbide in cast iron confers upon it many of its useful properties. If these bodies can be produced cheaply enough, however, there is strong probability that certain of them will prove very useful.

PHILOSOPHY IN THE COLLEGE CURRICULUM.

BY HOLMES DYSINGER, CARTHAGE COLLEGE, CARTHAGE, ILL.

STUDIES under the name of philosophy are to be found in almost every college curriculum. Either because the subject is too vague or abstruse for the comprehension of the average student, little more than elementary psychology, which is rightly regarded as a necessary part to the introduction to the subject proper, and a brief discussion of practical ethics, are taught in most of the schools outside of the few real universities. While the number of subjects advocated for introduction into the college course is increasing constantly, one so fundamental as philosophy should not be neglected. Apart from its theoretical value, it has practical bearings upon the intellectual range of a man, regardless of the system he adopts, that commend it to the thoughtful consideration of educators.

The subject-matter with which philosophy deals bears a peculiar relation to all other subjects in the course, in as much as its office is, partly at least, to systematize and explain all the principles of the particular sciences. This gives the unity so desirable in a course of study, and so essential to the thoroughly-trained mind. From this it serves the highest purpose in education and deserves a prominent place in every course of liberal culture.

The philosophical powers of man are last in order of development. The subject-matter makes it necessarily so. It is the most abstruse of all forms of knowledge. The mind in its unfolding passes up through perception and conception to the realm of widest generalizations and the discovery of the principles that are assumed in all our thinking. Philosophy deals with forms of knowledge that stand at the farthest remove from that furnished in so-called presentation — the first development in the mind's unfolding.

When the mind reaches that stage of development in which it apprehends the principles fundamental to all knowledge, it turns in upon itself and critically examines its own processes and assumptions to determine the certainty of being and the validity of our knowledge. This is the highest stage in man's intellectual ascent. Here he stops. He has completed the circuit of the globe of knowledge. He started with the facts furnished in sense and consciousness, and ends in the principles that underlie and embrace all knowledge. These stand accredited in his own thinking. Beyond this the mind of man cannot penetrate.

That many students cannot attain this stage of knowledge is evident to all who have taught the upper classes in our colleges; that but few who attempt it get further than the outer court, is to be expected; but that all are gr atly benefitted intellectually would not be denied by those who have looked into the merits of the case and examined the evidence with impartiality. A few additional facts will give our reasons for this conclusion.

Notwithstanding its abstruseness, as a discipline in thinking and in logical method, philosophy has no equal. Facts as furnished by the senses and distinguished from principles are not dealt with in philosophy, but the relation of facts to one another and to all things else. All these in a system of philosophy deserving of study or worth elaboration must be included in their relations of coördination and subordination. The unity of all b ing is the ultimate problem of philosophy. A narrower range and lower ideal may satisfy science, but it cannot attain to that which comprehends all knowledge. Only the mind well disciplined in logical method can grasp the facts, but the one who attempts to do so will develop a power that is the possession of few and the desire of all.

This apprehension of facts as related is essential and necessarily precedent to the discovery of principles which govern these relations. In this respect practical fruit is to result from the study of philosophy. Not simply philosophers, but even the students of philosophy, must get a more comprehensive grasp of facts and principles, as each is assigned its place in the whole system of knowledge. Truth is apprehended in its harmonies and wholeness. It is seen in its proportions.

If more attention were given to a careful study of philosophy as a system, rather than in its history, much of the conceit of knowledge which is so prevalent to-day would be unheard of. The specialist would soon discover that he was occupying a very small niche in the universe of knowledge; the broadest scholar that his horizon included but an infinitesimal portion of the sphere of truth.

BRITISH STONE CIRCLES. — III. DERBYSHIRE CIRCLES.[1]

BY A. L. LEWIS, TREASURER ANTHROPOLOGICAL INSTITUTE, LONDON, ENGLAND.

THE Peak district of Derbyshire, so justly famed for its scenery, possesses also many attractions for the archæologist, among which are two stone circles.

The larger of these, called Arbor Lowe or Arbe Lowe, is about six miles from Bakewell, and consists of an oval ring, the diameters of which were about 126 and 115 feet, the precise lengths being difficult to ascertain in consequence of the stones, which doubtless originally stood upright, being now all flat, and having fallen, some outside, some inside, and some across their original positions, while others are broken into fragments or buried in the soil. There were perhaps about forty stones, of which nearly thirty remain entire or in fragments, the largest being about twelve feet long, six broad, and four thick. The longest diameter of the oval ran nearly northwest and southeast, and somewhat more to the west and east, two of the stones seem to have stood back outside the regular line of the oval. Within the oval, and on the line of the longest diameter, but not in the centre of it (the distances from the northwest and southeast ends being in about the proportion of three to two), are the remains of some large stones — one fourteen feet long — which were apparently three in number, forming a "cove," |‾, like that in the centre of the northern circle at Abury, the central stone of which faced the rising sun on Midsummer Day. Like the circles at Abury, the stones at Arbelowe are surrounded by a ditch, which is about seven feet deep and fifteen wide at the bottom, outside of which is an embankment, formerly perhaps ten feet high and eight wide at the top; Sir G. Wilkinson says somewhat more, but it may be that he took the maximum and I took the minimum of the measure. This embankment is now very irregular, and in one place a tumulus has been formed from the materials composing it, in which were found two Celtic vases and a bronze pin. This tumulus could hardly have formed part of the original plan of the monument, and would therefore seem to have been made after the latter had fallen into disuse. The embankment, like that at Abury, is not a true circle, and there is much similarity in the irregularities of both, but that may be quite accidental. There are two entrances, one southeasterly, in the same direction as the Kennet entrance at Abury, and one to the northwest, but not quite opposite to the other; altogether Abury and Arbelowe, notwithstanding the great difference between them in size, have more points in common than any other circle has with either. Just outside the southeast entrance are two small stones, quite as likely to have been taken from the interior as to be in their original places. Nearly three hundred yards to the southwest is a tumulus, called Gib Hill, about twenty feet high and as wide at the top, in which a small cist was found, two feet under the surface, which contained a vase, two worked flints, and an iron fibula with places for stones — probably a secondary interment. A bank of earth of doubtful antiquity runs from the embankment for some distance in a direction south of Gib Hill. These various earthworks have been supposed to give the form of a serpent to the monument, but Sir Gardner Wilkinson's plan shows this idea to be quite incorrect; this is a point for the visitor to verify.

On the moors at the top of the hills above Eyam is a small circle of a different character from Arbelowe; it is called the "Wet Withins," and consists of a bank of earth, about six feet wide and two high, inside which, but close to the bank, was formerly a ring of small stones about two feet high and of proportionate size, of which ten remain, out of perhaps twenty or more. The diameter of this circle is about one hundred feet, and some sixty feet to the north-northeast there is a barrow, eighty-three feet long (from northeast to southwest) and forty-six feet wide.

There are some other small remains of a similar character in Derbyshire, but I have not seen them myself, and doubt whether they are worth the trouble of a visit.

[1] No. 1, Abury, appeared in No. 529, March 24; No. 2, Stonehenge, appeared in No. 537, May 19. To those who may wish for more minute details of measurements than can be given in a short article, I would recommend "Stonehenge," by Professor Flinders Petrie, D.C.L. (Stanford, London).

CHARAKA SAMHITA.

BY F. A. HASSLER, M.D., PH D., SANTA ANA, CAL.

THE student of Hindu literature has before him an ever-widening field of research. He must be prepared for glimpses and magnificent views of learning and wisdom which will astonish and delight him at every turn. The thoughts and the meth d of expression are different from those of other nations, and there is scarcely a subject, except, perhaps, electricity and steam, that has not been discussed by these ancient sages. The philosopher will find his theories, the anarchist his ideas, probed to the bottom, and thestudent of the supreme soul, high, noble thoughts, and even from this grand subject down to the every-day question of mistress and maid, we do not think of any matter that will not be found fully investigated in the pages of the Mahabharata.

So the physician of our day will find in the Charaka and other works of ancient India many views of health, disease, and remedies which he fondly imagined were jewels in the crown of modern science. When a young man wishes to study medicine, he may receive a little instruction from his pr ceptor, but places his chief reliance upon the teachings of some medical school from which he receives his diploma. This was not the custom in ancient India. There were no colleges. Every student became a part of his preceptor's household, was lodged and fed by him, and beyond a few light services was not asked for any return. It is plain that such teachers could not instruct all their scholars by word of mouth. This accounts for the immense number of medical works of ancient India.

We cannot tell the age of the Charaka, it is based upon a work of Agniveca, which carries us back to almost mythical times. The very name of this supposed author sounds like the mystery of long past ages, for it may be translated "the dwelling-place of fire." Ten years of study of the Mahabharata has led me to quite certain conclusions as to the time when that great work was written, and I should say that the style, of the first part at least, of the Charaka corresponds with that portion of the Mahabharata which I think was written about the sixth century before Christ, or, in other words, about the time of the rise of Buddhism. Whatever its age may be, this we know, it is exceedingly ancient. It is mentioned by Avicenna, Rhazes, and others, and is supposed to have been translated by the early Persian and Arabian writers on medicine. But we forget its age when we read its pages. The work is immense. An English translation, now being published by Doctor Kiviratna, the learned editor of several Sanscrit works and of a medical journal in Bengali, will probably cover from fourteen to fifteen hundred royal octavo pages. But it is not its size to which I wish to call attention, it is the wisdom and learning found in it that make it so valuable and interesting.

In a short article like this I cannot expect to do more than give the reader a glimpse of the work and a quotation here and there. We are told that in the earliest times some fifty-odd learned men assembled to study the science of life and the causes of disease; in fact, it was a medical convention similar to those of our day. The first conclusion they arrived at was that — "Freedom from disease is the excellent root of religion, profit, pleasure, and salvation. Diseases are depredators thereof, as also of happy life. This, therefore, is a great enemy of men that hath appeared.

What shall be the means of checking them? Having said this, they betook themselves to meditation."

They did not discuss questions of life and health only, but moral and religious subjects also, and their effect upon life in general. The wind, or breath, disorders of the billiary system and phlegm, or improper secretions, seem to have been fully recognized as causes of bodily diseases, while passion and darkness of mind brought about mental disorders. Long lists of drugs and directions for their proper use are given, and there is abundant evidence that the properties of vaccine matter were well known. We are told that "He who knows how to apply these in disorders is conversant with the science of medicine." And listen to the following in regard to drugs and those who use them: "He who is acquainted with their applications according to considerations of time and place, after having observed their effects on individual patients, should be known as the best of physicians. An unknown drug is like poison, or weapon, or fire, or thunder, while a known drug is like nectar. Drugs unknown by name, appearance, and properties, or misapplied even if known, produce mischief. Well applied, a virulent poison, even, may become an excellent medicine, while a medicine misapplied becomes a virulent poison. Only a physician who is possessed of memory, who is conversant with causes and applications of drugs, who has his passions under control, and who has quickness of decision, should, by the application of drugs, treat diseases."

Thirty-two kinds of powders and plasters and six hundred purgatives are next described, after which a chapter on food and its proper use gives us as good advice as is to be found in any treatise published in this learned nineteenth century. Great stress is laid upon the proper care of the teeth, and a list of plants is given from which brushes can be made, there not being manufactories of such articles as there are now.

"As the chief officer of a city protects his city, as the charioteer protects his chariot, after the same manner should the intelligent man be attentive to everything that should be done for the benefit of his own body." Therefore, bodily, mental, and, if we may so call it, religious hygiene is discussed at length, and many excellent rules given.

The question of the duality of the mind and of its connection with the understanding and the soul leads us into all the intricate mazes of Hindu philosophy, but are here discussed in such a lucid manner that one is not bewildered and can easily follow the line of thought with pleasure and profit.

"The objects of the mind are ideas. Here, again, the proper, excessive, scant, and injudicious correlation of the mind with its objects, or of the mental understanding with its objects, becomes the cause of the normal or abnormal condition of oneself." In other words, a man is sane or insane according to the proper or improper agreement of the mind and its ideas, the ideas the understanding conceives; and, therefore, "One should act in such a way as to preserve one's normal condition, in order that one's untroubled senses and mind might continue in an untroubled state; that is to say, by keeping oneself in touch with such objects of the senses as are productive of beneficial results; by properly achieving such acts as deserve to be achieved (and abstaining from such acts as should be abstained from), repeatedly ascertaining everything by a judicious employment of the understanding; and, lastly, by resorting to practices that are opposed to the virtues of the place of habitation, season of time, and one's own particular nature or disposition (as dependant upon a preponderance of this or that attribute or ingredient). Hence all persons desirous of achieving their own good should always adopt with heedfulness the practices of the good."

Selfishness was never a cause of happiness, and we are told "one can never be happy by taking or enjoying anything alone without dividing it with others." And this advice is good in every age of the world — "one should not trust everybody, nor should one mistrust everybody."

Hindu works teach that everyone should have complete mastery of his body and his senses, hence we frequently come across such a sentence as this: "One should not suffer oneself to be overcome by one's senses."

A very interesting chapter is that which treats of "The Aggregate of Four," that is, "the physician, nurse, drugs, and patient." Each is considered and as good advice as can be found given for the guidance of three of the aggregate. One thing, the first of the four, is taught which it were well to remember in our day; that is, that time must be considered in the treatment of all diseases, and one must not try to force a cure.

It would take more time and space than are at our disposal for us to consider all of even the four parts of the Charaka that have been published so far, but if any of our readers are interested, we would be glad to give them any information in regard to the work or the other publications of the learned editor of this great monument of ancient Hindu wisdom and leaaning.

A NEW THEORY OF LIGHT SENSATION [1]

BY CHRISTINE LADD FRANKLIN, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MD.

THE reasons which make it impossible for most people to accept either the Hering or the Young-Helmholtz theories of light sensation are familiar to every one. The following are the most important of them:

The Young-Helmholtz theory requires us to believe: (*a*) something which is strongly contradicted by consciousness, viz., that the *sensation* white is nothing but an even mixture of red-green-blue *sensations;* (*b*) something which has a strong antecedent improbability against it, viz., that under certain definite circumstances (e. g., for very excentric parts of the retina and for the totally color-blind) all three color-sensations are produced in exactly their original integrity, but yet that they are never produced in any other than that *even* mixture which gives us the sensation of white; (*c*) something which is quantitatively quite impossible, viz., that after-images, which are frequently very brilliant, are due to nothing but what is left over in the self-light of the retina after part of it has been exhausted by fatigue, although we have otherwise every reason to think that the *whole* of the self-light is excessively faint.

The theory of Hering avoids all of these difficulties of the Young-Helmholtz theory, but at the cost of introducing others which are equally disagreeable; it sins against the first principles of the physiologist by requiring us to think that the process of building up highly organized animal tissue is useful in giving us knowledge of the external world instead of supposing that it takes place (as in every other instance known to us) simply for the sake of its future useful tearing down; it necessarily brings with it a quite hopeless confusion between our ideas of the *brightness* and the *relative whiteness* of a given sensation (as is proved by the fact that it enables Hering to rediscover, under the name of the specific brightness of the different colors, a phenomenon which has long been perfectly well known as the Purkinje phenomenon); the theory is contradicted (at least the present conception of it) by the following fact—the white made out of red and green is *not the same thing* as the white made out of blue and yellow; for if (being mixed on the color-wheel) these two whites are made equally bright at an ordinary intensity, they will be found to be of very different brightness when the illumination is made very faint.

Nevertheless, the theory of Hering would have to be accepted if it were the only possible way of escape from the difficulties of the Young-Helmholtz theory. But these difficulties may be met by a theory which has the following for its principal assumptions.

In its earliest stage of development vision consisted of nothing but a sensation of grey (if we use the word grey to cover the whole series black-grey-white). This sensation of grey was brought about by the action upon the nerve-ends of a certain chemical substance set free in the retina under the influence of light. In the course of development of the visual sense the molecule to be chemically decomposed became so differentiated as to be capable of losing only a part of its exciting substance at once; three chemical constituents of the exciter of the grey-sensation can therefore now be present separately (under the influence

[1] Abstract from the Proceedings of the International Congress of Experimental Psychology, London, 1892.

of three different parts of the spectrum respectively), and they severally cause the sensations of red, green and blue. But when all three of these substances are present at once they recombine to produce the exciter of the grey sensation, and thus it happens that the objective mixing of three colors, in proper proportions, gives a sensation of no *color* at all, but only grey.

This theory is found, upon working it out in detail, to avoid the difficulties of the theories of Helmholtz and of Hering.

Its assumption of a separate chemical process for the production of the sensation of grey gives it the same great advantage over the Young-Helmholtz theory that is possessed by the theory of Hering; it enables it, namely, to account for the remarkable fact that the sensation of grey exists unaccompanied by any sensation whatever of color under the five following sets of circumstances—when the portion of the retina affected is very small, when it is very far from the fovea, when the illumination is very faint, when it is very intense, and when the retina is that of a person who is totally color-blind. This advantage my theory attains by the perfectly natural and simple assumption of a *partial* decomposition of chemical molecules; that of Hering requires us to suppose that sensations so closely related as that of red and green are the accompaniments of chemical processes so dissimilar as the building up and the tearing down of photo-chemical substances, and farther that two complementary colors call forth photo chemical processes which destroy each other, instead of combining to produce the process which underlies the sensation of grey.

Of the first four of the above enumerated cases the explanation will readily suggest itself; in the case of the totally color-blind it is simply that that differentiation of the primitive molecules by which they have become capable of losing only a part of their exciting substance at one time has not taken place; the condition, in other words, is a condition of atavism. In partial color-blindness and in the intermediate zones of the retina in normal vision the only colors perceived are yellow and blue. This would indicate that the substance which in its primitive condition excites the sensation of grey becomes in the first place differentiated into two substances, the exciters of yellow and blue respectively, and that at a later stage of development the exciter of the sensation of yellow becomes again separated into two substances which produce respectively the sensations of red and of green. In this way the unitary (non-mixed) character of the sensation yellow is accounted for by a three-color theory as completely as by a four-color theory. A three-color theory is rendered a necessity by the fact that it alone is reconcilable with the results of König's experiments for the determination of the color-equations of color-blind and of normal eyes,[1] experiments which far exceed in accuracy any which have yet been made in color-vision, but which, owing to the intricate character of the theoretical deductions made from them, have not hitherto been allowed their due weight in the estimation of color theories.

The explanation which the theory of Hering gives of after-images and of simultaneous contrast are not explanations at all, but merely translations of the facts into the language of his theory. My theory is able to deal with them more satisfactorily; when red light, say, has been acting upon the retina for some time, many of the photo-chemical molecules have lost that one of their constituents which is the exciter of the red sensation; but in this mutilated condition they are exceedingly unstable, and their other two constituents (the exciters of the sensations of blue and of green) are gradually set free; the effect of this is that, while the eyes are still open, a blue-green sensation is added to the red sensation with the result of making it gradually fade out into white, and, if the eyes are closed, the cause of the blue-green sensation persists until all the molecules affected are totally decomposed. Thus the actual course of the sensation produced by looking at a red object,—its gradual fading out, in case of careful fixation, and the appearance of the complementary color if the illumination is diminished or if the eyes are closed, – is exactly what the original assumption of a partial decomposition of molecules would require us to predict. The well-known extreme rapidity of the circulation in the retina would make it impossible that the partly decomposed molecules just referred to should remain within the boundaries of the portion of the retina in which they are first produced; and their completed decomposition after they have passed beyond these boundaries is the cause of the complementary color-sensation which we call simultaneous contrast. The spreading of the actual color which succeeds it would then be accounted for, as Helmholtz suggests, by a diffusion of the colored light in the various media of the eye.

No effort has hitherto been made to explain a very remarkable feature in the structure of the retina,—the fact that the retinal elements are of two different kinds, which we distinguish as rods and cones. But this structure becomes quite what one might expect, if we suppose that the rods contain the undeveloped molecules which give us the sensation of grey only, while the cones contain the color molecules, which cause sensations of grey and of color both. The distribution of the rods and cones corresponds exactly with the distribution of sensitiveness to just perceptible light and color excitations as determined by the very careful experiments of Eugen Fick.[2]

Two other theories of light sensation have been proposed besides the one which I have here outlined, either one of which meets the requirements of a possible theory far better than that of Hering or of Helmholtz; they are those of Göller[3] and Donders.[4] The former is a physical theory. That of Donders is a chemical theory, and very similar to the one which I here propose. Every chemical theory supposes a tearing down of highly complex molecules; Donders's theory supposes, in addition, that the tearing down in question can take place in two successive stages. But Donders's theory is necessarily a four-color theory; and Donders himself, although the experiments of König above referred to had not at that time been made, was so strongly convinced of the necessity of a three-color theory for the explanation of some of the facts of color-vision that he supplemented his four-process theory in the retina with a three-process theory in the higher centres. The desirableness, therefore, of devising a partial decomposition of molecules *of such a nature* that the fundamental color processes assumed can be three in number instead of four is apparent.

But the theory of Donders is open to a still graver objection. The molecules assumed by him must, in order to be capable of four different semi-dissociations, consist of at least eight different atoms or groups of atoms. The red green dissociations and the yellow-blue dissociations we may then represent symbolically by these two diagrams respectively:

But it will be observed that the two completed dissociations end by having set free *different* combinations; in the one case 1 is combined with 2 and in the other case 1 is combined with 8, etc. If, now, the partial dissociations are so unlike as to cause sensations of yellow and blue (or of red and green) it is not probable that completed dissociations which end in setting free *different* chemical combinations should produce the *same* sensation, grey. The difficulty introduced by Donders's theory is therefore (as in the case of Hering's theory) as great as the difficulty sought to be removed. It is the desire to secure the advantages of a partial dissociation theory, without the disadvantages of the theory of Donders, that has led me to devise a partial dissociation of molecules of a different kind. The theory will be found more explicitly set forth in the next number of the *Zeitschrift für Psychologie*.

[1] A. König und C. Dieterici. *Sitzungberichte der Berl. Akad.* vom 29 Juli, 1886.

[2] Studien uber Licht und Farbenempfindung. *Pflüger's Archiv*, Bd. XLIV., s. 441, 1888.

[3] Die Analyse der Lichtwellen durch das Auge. *Du Bois-Reymond's Archiv*, 1889.

[4] Noch einmal die Farben-systeme. *Gräfe's Archiv für Ophthalmologie*, Bd. 30 (1), 1884.

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THE CAPABILITIES OF PHOTOGRAPHY NOT UNLIMITED FOR ILLUSTRATING ALL CLASSES OF OBJECTS.

BY O. G. MASON, OFFICIAL PHOTOGRAPHER AT BELLEVUE HOSPITAL, NEW YORK CITY.

The comparatively recent departure from old methods in various fields of scientific research, has called into action agencies for solving problems of initial progress and results not known or utilized by earlier workers. Discoveries within the last few years have so advanced the lines of study, and an active scientific press has scattered so broadcast the knowledge of progress made that, although the field is boundless, he who reads has little excuse for reworking ground from which all reachable fruit has been gathered. In eagerness for the new, a desire to find some hidden, shorter paths into the mysteries of nature, do we not often fail to recognize obstacles, or to sufficiently consider the best means for their removal? With pen and pencil our predecessors sought to leave a record of their work. What they thought and what they saw have been handed down to us through the best means at their command. For the physician, the botanist, mineralogist, and the geographer the artist sketched, elaborated, and finished illustrations having a more or less amount of truth, often obscured by some personality, which rendered them valueless or even misleading. In no class of objects have such defects been more conspicuous than that requiring the use of the microscope. Therefore, he who had used with dissatisfaction the hands of the draftsman was eager to utilize the means offered by photography. He had seen the results obtained in other fields, and, without knowing the difficulties in the way, believed it easy to obtain all desired brilliancy, detail, and amplification. It may be asked, Why have not these expectations been more fully realized? When we pause to consider that color is a most important feature in photographic work, and that a majority of objects studied under the microscope reflect or transmit the least actinic rays of light, red, orange, green, and yellow, we may well understand why we do not secure brilliancy. Again, when the microscopist studies his subject for detail, he mentally eliminates all those parts which do not belong to the special point under observation. A crystal, cell, or fibre which over- or underlies his object or forms a full or partial background in the field of the objective is left out in the mental summing up of his study. The laws of chemistry and optics do not permit such selection and elimination from the photographic image. A slight tremor conveyed to the microscope by a passing vehicle in the street, a step about the room or house, may be annoying to the observer, but does not prevent securing results by longer application. But when we consider the necessity of absolute immobility of the instrument, often for a considerrble length of time, in order to impress upon even the most sensitive plate the image of many-colored objects, we can well understand one of the greatest causes of failure to secure detail; and this obstacle of motion becomes far greater as the amplification increases. It is plain that motion is multiplied equally with the diameter of the object; or, in other words, if we magnify an object one thousand diameters, a motion of that object to the extent of one-thousandth of an inch becomes in the amplified image a motion of one inch, which very readily shows why good results cannot be obtained under such conditions. When observing with the microscope, it is possible and quite feasible to focus the instrument above and below the general plane of the object, in order to study any projecting points which may be within or without the general plane. This feature is not possible with the photographic process, save in so far as diaphragming the lens and modifying the light may effect the result. *Over*estimation of the possibilities of photography and *under*estimation of the careful preparation of objects have occasioned much unnecessary labor and great disappointment by failure to produce results which should be sought through different channels. When the investigator contemplates the employment of photography for illustrating his work, let him consult his photographer before preparing his objects. No one human being has yet encompassed *all* that is known. When the anatomist takes to his photographer a *thick* section of muscular or ossified tissue and asks to have the individual striæ and cells isolated and delineated with distinct outlines and minute detail, he will fail to realize his expectation. When the mineralogist or geologist prepares his sections of crystallization or deposits, he must not calculate that *all* his various planes will be perfectly shown in one photograph, even if the specimen *be* translucent. Color, mass, and position are important factors in all photographic work. With orthochromatic plates many objects heretofore impossible of proper illustration may be quite successfully treated; but, with objects of this class, another factor, that of time of exposure, offers a barrier of limitation. The mobility of life, animal and vegetable, is a most important element which cannot be ignored in exposures of hours, or even minutes, and seconds. A vegetable fibre, when placed in concentrated light, may make one or more entire revolutions during the time of exposure necessary to properly impress its image upon an orthochromatic plate; and especially is this the case when a high-power objective is used. Thin sections devoid of the less actinic colors, red, orange, yellow, and green in their darker tints, or admixtures, may be easily treated. Circulating fluids or objects changing size or position are susceptible of instantaneous exposures only. When such objectionable features as motion and non-actinic color are present, the problem becomes far more complicated, and if the photographer fails in its clear and complete solution his patron sometimes looks upon such failure as a proof of incompetency or a lack of proper effort. Like her sister handmaids in the advance and illustration of scientific thought, photography stands ready to do her proper work. She has done much, and it is believed will do more to enlarge the field of human knowledge and gather the harvest; but we should not ask her to accomplish the impossible.

LETTERS TO THE EDITOR.

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

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

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

Worms on the Brain of a Bird.

In the issue of *Science* for June 2, is a short account of my finding thread worms in the brain cavity of *Boturus mugitans*. The title of the article should have read "on" instead of "in," as they were not in the tissue of the brain but, as I state there, in the subarachnoid space.

Since writing the short article above referred to I have received a card from Professor J. W. P. Jenks of Providence, R. I., in which he gives an account of his investigation of a similar if not the same parasite on the brain of the Snake Bird (*Plotus anbingus*). To quote a little from his communication, he says:

"In 1874 I camped for 50 days near Lake Akechobee in south Florida, and shot dozens of the Snake Birds, and in 19 out of 20 mature birds found a bunch of 10 to 20 parasitic worms just beneath the arachnoid membrane, but in no instance extending into the substance of the brain. In young just hatched I never found any. In young from two to three weeks old I found them in their stomachs and the alimentary canal. When about ready to fly I found coiled perhaps two or three on the brain."

Further on in his note to me he says: "I was surprised to learn of your finding them in *Boturus*—but I should not have been for I consider them primarily a fish parasite and developed from the eggs taken with the fish into the stomach of the bird, and hence like *Trichina spirulis* finding their way to the brain."

Professor Jenks called my attention to a note he published on this find in his "Popular Zoology," but which I had overlooked. He also gave me the address of Dr. W. Cahall of Philadelphia who had published an article on the subject, based largely on the material Professor Jenks obtained from Florida There is only one point in Dr. Cahall's article (Journal of Nervous and Mental Diseases for June, 1889), that I wish to speak of, and that is that while 19 out of 20 Snake Birds have these brain parasites they do not seem to affect them unfavorably. This was not the case with the Bittern. It was poor in flesh, of inferior size and deficient in intelligence.

That birds do get parasites from fish I might add the following case of circumstancial evidence: When skinning a perch (*Perca flavescens*), I found in the muscles a number of encysted parasites, the cysts white and about an eighth of an inch long A short time afterwards in skinning a wild duck I found a similar if not the same parasite in the pectoral muscles. The two parasites were of the same size and color and seemed to be the same.

G. H. FRENCH.

Carbondale, Ill.

The International Botanical Congress at Madison.

IN looking over the "Circular and General Programme of the Forty-Second Meeting of the American Association for the Advancement of Science" just distributed, I am surprised to read on page 12, under the heading "International Botanical Congress," the following statement: "The congress will consider questions of general botanical interest, but papers embodying the results of research will be excluded. The International Standing Committee upon Nomenclature, appointed last year at the Genoa Congress, is expected to present a report at this time." This is all that is said in the circular to indicate what we may expect to hear at the Congress.

The *Botanical Gazette*, in an editorial,[1] urges "If any botanist has a suggestion . . . now is the time to give it expression. . . . Silence means apathy." I fear a certain class of our botanists have been silent too long, judging from the above statement. It seems to me outrageous to announce a programme from which all original research is excluded. No scientific man cares to listen to papers which are merely "a play of words," not the results of research. I should consider it an insult to our foreign guests to offer such a programme. The one subject suggested, *nomenclature*, is indeed about the only one possible under such restrictions, being truly void of all scientific research.

Botanical congresses do not come every year, especially in America, this being the first ever held here, if I am rightly informed. This being the case, it seems to me, as a matter of course, that this should be the time and place for a discussion of the vital questions of physiology, morphology, anatomy, etc., that this should be the time for an extreme effort on the part of every American botanist. If we desire to gain standing as true botanists among the true botanists abroad, our supreme effort should be directed to *botany*, not as appears to be the intention, to a mere machine of botany. It would seem a better restriction if all papers *not the result of research* were excluded.

Papers from America have long presented this characteristic — no "result of research." Nomenclature and floristic is truly all that we have thus far accomplished. One is, unfortunately, compelled to believe that "Free Lance"[2] accidentally omitted to include botany when he said: "The Entomological Society is recruited very largely from the ranks of 'collectors' who notoriously infest entomology far more than any other branch of natural history." The omission is at least unfortunate. The following sentences of the paragraph are so pithy and to the point that I cannot refrain from quoting them also: "The great majority of these have probably no interest in science generally, but care only for those things relevant to butterfly collections (herbaria, in our case). They would never become Fellows of the Linnæan, and care chiefly to discuss 'collectors' topics, that would be quite out of place in that society; so that the Entomological Society affords them a soft purgatorial limbo, midway between the paradise of science and the inferno of popular nescience."

I trust that I missunderstand the word *research* as used by the committee, but it would seem desirable that they should better explain what is meant. It may be intended that all papers containing research should be presented to Section G of the American Association, fearing that if the congress were not restricted Section G would be scantily patronized. This, however, does not seem a reasonable interpretation, for if there is a limitation on the congress, we should expect it to be open only to the best papers of most general interest, which could readily be decided by a committee on programme; lesser papers and papers of local interest being referred to Section G.

The claim cannot be made with justice that nomenclature has more than a factional interest. The majority of good botanists of the world pay no attention to nomenclature, and to them a discussion of its intricacies would be dry and worthless in the extreme. If such factional questions are to be the only ones considered, the congress should not be called a "Botanical Congress," but a *Nomenclature Congress*. Whatever may be intended, it is an unfortunate use of words.

It is announced that a separate circular will shortly be distributed to botanists, giving further information. It is to be hoped that a clear explanation of this point will be given.

H. J. WEBBER.

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[1] Botanical Gazette, vol, xvii. (November, 1892), p. 384.

[2] "On the Organization of Science," by A. Free Lance, Edinburgh, 1892, p. 25.

A Plea for a Fair Valuation of Experimental Physiology in Biological Courses.

DURING the discussion of the biology question, one point has interested me more than any other, namely, that none of the parties who have taken part in the discussion have been able to avoid speaking at the same time of evolution and of natural selection. This thinking of biology, with constant reference to those two features of Darwinian teaching, has led me to believe more strongly than ever that my view of the matter is not very much wrong. However, an article in this journal, entitled "Biology in our Colleges: A Plea for a Broader and More Liberal Biology," induces me to take up my pen once more and explain matters a little more closely.

The tendency of the above-named paper "is — a plea for systematic biology," but it is marked by such a number of wonderful views on the different lines of physiological investigation that many specialists will really be at a loss about what they shall think. "Systematic zoölogy has gone, or, if still tolerated in a few colleges, is restricted to a very subordinate position." I imagine that the biologist would not know what to do if systematic work, both zoölogical and botanical — the latter holds still, says the article, "an honored place in many universities, though evidently on the wane" — was not carried on, so that we could know how to lay our hands upon the different forms for further study. But the methods of such a work may be wrong, and, fatally, often are so, namely, when it presents itself merely as simple regristation work, which strikingly has been called museum zoölogy or botany. Systematic work of any kind is to be valued just as much as morphological or physiological work, and so, even if it is done still — as in fact it is in ninety-nine cases out of a hundred — after the old Linnæan principles. On the other hand, a biological classification, or even only a morphological classification, which employs biological characters of the forms, is to be more highly valued.

There is no doubt but that any naturalist enjoys the "delight n contemplating the aspects of nature," and "derives enjoyment from studying the forms, habits, and relationships of animals and plants," but how can he do so, and thus become a "biologist," unless he peers "through the tube of a compound microscope," etc., and does his proper hardening, and staining, and "monographs the same bit of tissue." How such investigations can "obscure the objects" we are trying to explain is rather a mystery. If, at least, anybody allows them to obscure our general views, there can be no speaking of scientific work. Natural history has become, in our century, so broad that no man possibly can become a "general naturalist" or a good "faunal naturalist" any more; he will, at least, not be able to treat all the questions that arise in any other way but in that of the amateur. The objects of our investigations lie a little deeper than to glance at all that is "most beautiful" and attractive to the eye.

How the article comes to the conclusion that the study of the minute structure is histology or that of development embryology, is rather doubtful. Further, I am anxious to know if any of the readers walking over the scientific border-land commanded by the naturalist who might be educated according to the principles given in the article of which we speak did ever meet with "the various pathogenic micrococci of fermentation and disease" which are mentioned (p. 353). However, I shall not enter upon further details, but turn towards the view expressed in the said article about "section-cutters and physiologists," and I shall try to show that the work done by the workers in this particular field is far from being one-sided, at least, when we are speaking of real scientific men who put an equally fair valuation on all of the branches of their science. There are, as Professor E. L. Greene said, "a good many men trying to figure somewhere" as scientific writers, but where are the scientific men to be found when we look towards the "scientific border-land" (Greene)? Therefore, we shall see that the right sort of scientific physiologists do not dare to depreciate any of the branches of their science.

Professor P. L. Panum once said that he who would not acknowledge physiology as the fundament of pathology and of the other departments of medical science has no right to be called a scientist. The vegetable physiologist who does not know anything about the principles of agriculture, horticulture, and forestry also loses this right, and so he does, if he is ignorant with regard to a great deal of the practical, industrial branches. If we go to the opposite side, he must know how to carry out more minute investigations; he cannot avoid being something of a "slice-cutter," and if he should be unfortunate enough to find "some new form of cell or new property of protoplasm," he must understand how to trace such a discovery as far as it can be traced. I am, therefore, very much surprised to hear that "the modern school of histologists, under the head of biology, teach little besides the minute structure and function of tissues." For my personal account, I have studied physiology almost from the time when I could appreciate the blessings of the study of natural history, but I have never met a man who claimed to be a physiologist,— *in casu* vegetable physiologist,— and who, speaking, for example, of the nitrogen question, did not know the theoretical investigations quite as well as the practical experiments with fertilizers. But it must be noted that natural science has, at present, reached such an extent that no man possibly can cover the whole ground. Thus we have, with regard to special work, to become specialists, and, therefore, it is possible to take a farmer's boy and make out of him "a general naturalist of the present day" or a "local faunal" — or floral — "naturalist." He will be no scientific man.

"Biological" teaching is a failure for other reasons than those presented in the article. A college professor may offer a course in "general biology" and include "cell structure and the structure of the less complex tissues of animals and plants." But this is not "general biology;" the structure of two different forms has not the least to do with biology, it comes under the heading of internal or external morphology, and, when making a study of this kind, the student does not see more of life in general and of the laws by which it is governed than he saw before. Here the experimental physiology of animals and plants must be held up before a school of "biologists" who are following a phantom of their own imagination if they really believe that function can be explained out of form. It is here that "the pendulum has swung too far," and it is not in the direction of "exclusive microscopic and physiologic work." The latter is safe enough. The fault lies entirely in the methods of modern biology, which begins with giving itself a wrong definition. If the modern biologist had cared more for experimental physiology, he would know now how to direct his actions when the pendulum "swings back."

If I understand the article aright, the student should begin his biological work with elementary "general biology." He will, then, come to the university without, practically speaking, knowing anything about "biological" questions, and he will plunge into the study of cell-structure at once. This beginning of a course would be anything but beneficial to the young, ignorant student. If we take the example of the farmer's boy, he would naturally have to start with the study of what we call external morphology, collect plants, insects, or shells, and perhaps study their ways. It would be entirely lost on him to train him in the study of the cell and its organs. The other special sides of biology which are proposed for study are: 2. Morphology, taxonomy, and relationships; 3. systematic work in widely-separated groups; 4. faunal work; 5. the distribution of life in time and space; 6. the principles and philosophy of biology.

These are the constituents of "biology!"

If it were so, the condition of natural science would be very lamentable. Not a single word or hint is given about the existence of experimental work, which should be the main factor in the whole course of training. It is true, as has been said, that "sham" is a hard expression, but here it might be used very properly. Many of the "biologists" of the present day will hardly understood my view, because they have been taught to regard the study of morphology as the essential part of their biological studies, but the physiologists will do so, because they know that we can take but very few steps in any direction without experiment. So long as biological courses do not include a proper course in experimental physiology of animals and plants, they cannot be called properly scientific. Anybody who will not believe this may be referred to Paul Bert's "La Science Experimentale."

There is no danger that I should have misunderstood the article. I see clearly that it wishes the "systematic biology," which might have been called, more logically, biological classification, to take a place a little more ahead of what it holds at present. But, trying to give a fair valuation of the other branches of physiology, it fails entirely. It is well known how language can command the thoughts, and if biologists go forth without knowing what they are teaching, the present confusion will grow instead of being settled. Perhaps "biology" will gain more and more lovers and become (as it is) very fashionable, but the amount of restless work, chasing new problems and pursuing all that is interesting merely because it is new, will not, in time, be very much valued. Nothing can save "biology" except experimental physiology.

J. CHRISTIAN BAY.

Missouri Botanical Garden, July 7.

Mr. McGee and the Washington Symposium.

It strikes me as curious, and certainly contrary to scientific usage, that the succinct statements made by Mr. King as to the limitations of his inferences on the earth's age are ignored by our Washington friends. One might actually imagine that we were not on the scent of polymerism [1] considered either with reference to its volume or the inseparable thermal effect; or that we were unaware of the high pressure and long range thermal variations of the physical constants of rocks. It takes so little time, so little cerebration to adduce critical commonplaces of this nature,

[1] If there was one subject in which we imagined that our work had reached the point of prolixity, it was the change of chemical or molecular constitution as resulting from temperature and stress. (Cf. Am. Journ., xxxiii., p. 28, 1887; ibid., xxxvii., pp. 339, 351, 1889; ibid., xlii., p. 498, 1891; ibid., xliv., p. 242, 1892; etc.; Phil. Mag., xxxi., p. 9, et. seq., particularly § 25, 1891; ibid., xxxv., p. 174, § 3, 1893; Am. Chem. Journal, xii, p. 1, 1890; Bull. U. S. Geolog. Survey, No. 94, 1892; and elsewhere). And now comes Mr. McGee with obviously well-meant instruction on the feasibility of our polymeric mechanism.

that they are always bountifully forthcoming. But the things which one really wants, the physical character of an alleged discrepancy, its numerical value, the so-many per cent of error under such conditions,— these one is left to wish for in vain, supposing that one has not long since learned to pay the personal groaning for the personal satisfaction. So far as I am concerned, if I could not adequately state how big a sin it is under which somebody else is staggering, I should prefer to hold my peace, believing that matters of vague conjecture are not fit to be chronicled. Nobody on the same side of common sense would to-day attempt to exhaust so complex a problem as the one in question in a single instance. It is reasonable, however, to try to remove piece by piece, element by element. What we did was an endeavor to remove the preponderating element, and I must re iterate that if our respite had not been cut short by recent unfavorable legislation, other things would have been brought out in their turn and in due time. Perhaps it is heresy to state that an immense future awaits laboratory research in physical geology; but stating it, one would like to refer not so much to the punching of clay or the pulling of taffy candy, as to legitimate physical measurement However, others have survived even the odium of cultivating "exact" methods. We are soothing ourselves with the comfort of so thinking.

CARL BARUS.

Phys. Laboratory, U. S. Weather Bureau, Washington, D. C.

The Lac de Marbre Trout, A New Species.

DESCRIPTION: B. 11 12; D. 13; A. 13; V. 9; P. 14; Vertebræ, 60.

The specimen described is about twelve inches in length. Body subfusiform, compressed, pointed at snout, slender at the tail. Height of body near one-sixth of the total length; head one-fifth, crown convex. Snout one and one third, and interorbital space one and one-half times the eye. Eye little less than one-fifth of the head, two-thirds of the space between the orbits on the forehead. Mouth large; maxillary straight, extending backward almost as far as the hinder edge of the eye, bearing strong teeth on its lower edge for nearly its entire length. Teeth on intermaxillary and mandibles stronger. The tongue bears a series of four strong hooked teeth at each side, and behind the glossohyal on the basibranchials there is a band of several series of smaller ones. Gill rakers straight, short, sharp, rough, 8 + 14 on the first arch. Opercle thin, with a few striæ. Scales very small; apparently there are about two hundred and thirty in the series immediately above the lateral line and more than two hundred and fifty in a row five or six scales above this. Distance from first ray of dorsal to end of snout little more than that from the same ray to the tip of the adipose fin. The middle of the total length falls halfway between the ends of the hinder rays of the dorsal and its base. Dorsal and anal fins are slightly emarginate at the ends of their median rays. Pectorals and ventrals small; base of latter slightly behind the middle of that of the dorsal. Caudal pedicel slender, notch very deep, hinder border sinuous, as in Salmo alpinus, lobes pointed. The caudal notch is deeper in this species than in any other of the American forms except S. namaycush.

Back dark brown with an iridescent blueish tint, unspotted. Dorsal dark, clouded, without spots or bands. Pectorals, anal and ventrals orange in the middle, yellowish or whitish toward bases and at their margins. The dark color of the back shades into whitish tinged with pink below the lateral line. Ventral surface white, no doubt reddish in breeding season. Head black on top, silvery on the cheeks, white beneath. Flesh pink. Caudal fin yellowish toward the base, brown toward the hinder border, which has a narrow edging of light color. Faint areas of lighter tint suggest a few spots of red in life along the lateral line; the condition of the specimens is such that this may be left in question, as also the number of caeca or presence of parr-bands of which there are faint indications

This fish is evidently allied to the blue-back of the Rangeley Lakes, S. oquassa, but reaches a greater size than that species, and is readily distinguished by the maxillary and its dentition, the caudal fin, and the coloration. Similarly when compared with S. arcturus, S. stagnalis and S. Rossi, it is seen to be quite distinct. With the saibling, S. alpinus, introduced in Sunapee Lake and elsewhere, it has still less in common.

Our specimens were taken in Lac de Marbre, Ottawa County, Province of Quebec, Canada, whence they were sent by favor of the Hon. J. G. A. Creighton. They reached us at the instance of Mr. A. N. Cheney, fishing editor of *Shooting and Fishing*, who when asked to suggest a specific name replied with the question, "How would it do to name it for Mr. R. B. Marston, editor of *Fishing Gazette*, London, an Englishman overflowing with good feeling for everything pertaining to fish, fishing and America, and who is doing much to enhance friendly interest between the people of the two countries?" In consequence of the suggestion this handsome char, one of the handsomest of our species, is introduced under the name, *Salmo* (*Salvelinus*) *Marstoni*.

S. GARMAN.

Mus. Comp. Zool., Cambridge, Mass.

Tucumcari.

THE writer first visited this historic locality in 1887, before he had had opportunity to define the Denison beds at the top of his Lower Cretaceous section in northern Texas, and fell into the error, which others have not escaped, of concluding, from the peculiar Jurassic-like *Gryphœa dilatata*, Marcou, the only fossils found upon that visit, that the beds were Jurassic, and so published his opinion.

Later, however, after having had an opportunity to complete his study and arrangement of the stratigraphy of the Comanche series in central Texas, he discovered in the Denison beds[1] of his Washita Division certain features which led him to believe that his early diagnosis of the Tucumcari beds was erroneous, and that they were really closely allied in age to the Denison beds. Under this impression, which was communicated orally to all interested, he availed himself of the first opportunity to revisit Tucumcari, April 30, 1891. He then discovered in association with *G. dilatata* the list of additional species herewith given, and, at earliest opportunity, under date of May, 1892, published, in a general discussion of the region, the following revision of his previous conclusions, which was the first printed announcement of the Cretaceous age of the *G. dilatata* beds: —[2]

"The Trinity Sands and Red Bed Regions.

"The writer has twice visited the Mesa Tucumcari and found it a most interesting geological remnant of the former area of the Llano Estacado. The table or summit described by Capt. Simpson is covered with the typical Llano Estacado formation, identical in composition and formerly continuous with the sheet which covers the Llano proper, some 20 miles distant. Below this is a vertical escarpment of 50 feet or more of typical Dakota sandstone resting upon loose sands and clays, forming a slope identical in aspect and fossil remains with the Denison beds of the Washita Division, which have been eroded away from the 400 miles intervening between it and the main body of those beds at Denison, Texas. Beneath this is a large deposit of the typical Trinity sands *country*[3] of white pack sands, thin clay seams, and flagstones, while the base is composed of the typical vermilion sandy clays of the Red Beds."

Notwithstanding the above clear statement of my opinions, the Third Annual Report of the Geological Survey, printed nearly a half-year afterward, devotes many pages to asserting that I held to the Jurassic age of the *O. dilatata* beds at Tucumcari. Upon pointing out this misquotation, instead of acknowledging the error, and repairing the injustice, it was followed up by a privately

[1] Denison beds as originally defined and used by writer. Not the Denison beds of Taff, as used in an entirely different meaning. Compare Bulletin of Geological Society of America, Vol. II., p. 501, and Third Annual Report of Texas State Geological Survey.

[2] "On the Occurrence of Artesian and Other Underground Waters in Texas, Eastern New Mexico, and Indian Territory West of the 97th Meridian," by Robert Thomas Hill (being part of Vol. III. of Senate Document 41, 1st Session, 52d Congress, Washington, May, 1892.

[3] For "country of" read "consisting of" — a typographic error.

printed, bitter, and vindictive attack upon my report, endeavoring to discredit all the work I had done in the Texas region. This last-mentioned paper is so utterly incorrect in its assertions, and so malicious in tone, that I do not think it needs other answer than a perusal of it. Certainly it has no place in scientific literature, and if any of my friends should be so deceived by it as to believe any of its assertions, I shall be glad to clear any doubts by correspondence.

In *Science* of May 26, 1893. p. 283, the author of the foregoing attacks again misquotes me by saying that after my second visit to Tucumcari I again affirmed Marcou's reference, an assertion which has no foundation, for hardly had the two lines after my first visit been printed before I realized my mistake, and orally communicated it to everyone interested, and have never since maintained by word or pen, and was the first to publish the true age of these beds.

It was impossible, in a general report written upon the subject of Artesian Water, to go into controversy over the age of a fossiliferous horizon. I had given a full outline of the region with its broader problems in a Bulletin of the Geological Society of America for 1891, entitled "Notes on the Texas New Mexico Region." In this paper I clearly set forth the Tertiary age of the Llano Estacado, and amplified many points which have since been published entirely *de novo*. Inasmuch as several parties have criticised me in public print for not giving the minutiæ of Tucumcari, I submit the following amplification of my previous remarks, and hope it will prove satisfactory to all fair-minded readers.

Section of Tucumcari Mesa.

Preliminary.

		Thickness (estimated on spot).
6.	Summit of Mesa (Neocene). White, calcareous, silicious, marly limestone of character peculiar to Tertiary formations of Great Plains	25–30
5.	Escarpment around summit of Mesa (Dakota). Consisting of the massive brown-yellow sandstone, which I had traced for days from LaMora, and other points on the Las Vegas Plateau, and which Stevenson had called (I think properly) Dakota. Estimated to be about	75
4.	Crumbling yellow sandstone at base of above, and (4a). Gentler slope, forming bench around summit escarpment, (Washita) Division of Comanche series. Decomposing sandstone of base of 4, and arenaceous clays and marls. Containing fauna of Denison beds, Washita Division at top, and *G. dilatata*, Marcou, in debris, apparently weathered out	100
3.	Shoulder at base of above. Impure, yellow, arenaceous stone	15
	Pedestal, or lower slope of Mesa.	
2a.	Upper part (Trinity). White and red unconsolidated sands (pack sands), with thin strata of dimension-layers of hard quartzitic rock, and thin layers of blue clay, resembling in general character the Potomac sands of Maryland and the Trinity Sands of Texas. This horizon contains a peculiar granular mineral, resembling red coral, and outcrops in all the escarpment of the Las Vegas Plateau on the north side of the Canadian, and is denominated the white band in that region, to distinguish it from the brown band (Dakota) and underlying Red Beds	150
1(b)	Lower portion of slope (Pre-Cretaceous). Bright, vermilion, argillaceous clays of the Red Beds continuing to bed of Canadian	250

The above section is not final or complete in details of the individual beds, but it illustrates the sequence of the four great formations as preserved at Tucumcari and in the adjacent Llano Estacado, and shows the geologic position of the following fauna, which were collected near the summit below the base of the sandstone escarpment which surrounds it, in beds numbered 4 and 4a.

List of Fossils.

1. *Turbinolia texana*, Conrad. United States and Mexican Boundary Survey.
2. *Ostrea* (*Gryphæa*) *dilatata*, Marcou. Geology of North America.
3. *Ostrea quadricostata*, Shumard. Transactions Academy of Science, St. Louis, 1860.
4. *Plicatula*, species undescribed.
5. *Neithea occidentalis*, Conrad. United States and Mexican Boundary Survey.
6. *Trigonia emoryi*, Conrad. United States and Mexican Boundary Survey.
7. *Protocardia multistriata*, Con. United States and Mexican Boundary Survey.
8. *Turritella marnochii*, White, or *Seriatim granulata*, Roemer.
9. *Ammonites leonensis*, Conrad. United States and Mexican Boundary Survey.

In addition to the above there are four species of Pelecyopoda, which I am unable to determine generically, but they resemble *Astarte*, *Lucina*, *Panopæa*, and *Isocardia*.

All of the species enumerated, with the exception of No. 2 (*G. dilatata*, Marcou), occur elsewhere in the greatest abundance and similarly associated in the Washita Division of the Comanche Series of Texas and Mexico, and, with the exception of Nos. 5 and 8, have never been found in any other beds than those of the Washita Division. Nos. 5 and 8 range downward into the Fredericksburg Division.

No. 1 (*Turbinolia texana* Con.) has not been reported east of the Pecos, but it occurs near El Paso, and at Arivichi, Sonora (as shown by Gabb), associated with a fauna similar to that of Tucumcari.

The forms from No. 2 to No. 9, inclusive, are the most common and characteristic species of the Washita Division, and can be collected at nearly any locality where the entire division is exposed, between Marietta, Indian Territory, and the Rio Grande.

The ammonite is the common, characteristic ammonite of the Fort Worth beds of the Washita Division, at Denison, Fort Worth, Austin, and elsewhere, and has hitherto not been found except in the Fort Worth beds of the Washita Division.

Ostrea quadricostata, Shum., *Trigonia emoryii*, Con., and the other species mentioned are especially characteristic of the Denison or uppermost beds of the Washita Division, at Denison, and hence my reference of these beds at Tucumcari to the Denison beds of the Washita Division.

As I have previously maintained, *G. dilatata*, Marcou, is a good species, entirely distinct from *G. pitcheri*, Morton, and, as has been said, has remarkable resemblance to the Jurassic *G. dilatata* of Sowerby. Under these conditions it is not strange, then, that before the stratigraphic and paleontologic position of the Washita Division was known, that the distant Tucumcari beds should have been adjudged Jurassic upon the evidence of the two species collected therefrom by Marcou, which certainly have, when considered alone, a most Jurassic aspect.[1]

The section and list of fossils above given differ in detail from those published on page 208 of the Third Annual Report of the Texas State Geological Survey. The two lists, however, both show the *Gryphæa dilatata* beds to be of the age of the Washita Division of the Comanche Series, and the author of the Texas report, which was printed several months after the writer's, came to the same conclusion, although he seems to have been unaware of the fact that the writer had abandoned his early reference of the *G. dilatata* beds to the Jurassic. With the exception that the beds which the writer refers to the Trinity, are referred by the Texas author to the Triassic, there is no dissimilarity between their conclusions.

Following is the list of fossils published in the Texas reports, "collected from the Tucumcari beds in the vicinity of Tucumcari

[1] *Gryphæa dilatata*, var. *tucumcari*, Marcou, and *O. marshii*, Marcou.

and Pyramid Mountains." It is unfortunate that the exact locality of the collection is not given:—

Gryphæa dilatata var. *tucumcari*, Marcou.
Ostrea marshii, as determined by Marcou.
Gryphæa pitcheri, Morton,
Exogyra texana, Roemer.
Ostrea quadriplicata, Shumard.
Trigonia emoryii, Conrad.
Cardium hillanum, Sow.
Cytherea leonensis, Conrad.
Turritella seriatim granulata, Roemer.
Pinna, Sp.
Ammonites.
Pecten.

Finally, the writer wishes to state that he is not prepared, nor does he desire, to write a final treatise on the Tucumcari, which can never be properly related until the atlas-sheets of the United States Geological Survey are completed for the region. Tucumcari is but a single station in the vast group of phenomena belonging to the deposition and degradation of the Las Vegas and Llano Estacado Plateaus and the Canadian Valley, and to be properly understood, it would be necessary to write a treatise on the whole region. One thing is settled beyond all doubt in my mind, however, and that is that the *G. dilatata* beds of the region do not belong to the Jurassic, but are undoubtedly of Cretaceous age. On the other hand, it may also be safely assumed that the *Gryphæa dilatata*, Sow , of Marcou, is not the same as *G. pitcheri*, Morton, as has been asserted by many authors, nor does it occur in the Cretaceous beds of central Texas, so far as the writer is aware. But this is a question which cannot be discussed intelligibly until a thorough revision of the Gryphæas is made.

In conclusion, permit me to say that there is not one trace of the Jurassic formation over the Texas region, as Mr. Marcou so positively affirms, and, furthermore, that there is no evidence that it was ever there, the whole trend of the testimony being to show that that region was land during the Jurassic period.

If the writer should devote his time to criticising the works of his contemporaries or predecessors, he would have little time for research. It has been my practice, however, under the opinion that all knowledge is progressive, to see the good in the works of others, and to correct any errors without abuse. In all I have published on the Texas region, there is not a line which was written with the desire to discredit any man, and yet I believe that my severest critics will confess that there has been great advance in opinion since I undertook the renaissance of geologic study in Texas.

My collections from Tucumcari are in Washington, and are open to the inspection of anyone interested. ROBT. T. HILL.

Chloropia.

THE case of Wallian, reported on page 360 of the latest volume of *Science*, would seem to be one of temporary *Chloropia*. More extended and carefully recorded observations, while the observer is looking at various objects under various conditions, would be very desirable. E. W. SCRIPTURE.

Yale University, New Haven.

Trees as a Factor in Climate.

I ONCE observed a signal case of the effect of trees in determining rainfall. A few years ago I was walking along a road in the so-called backbone of England at an elevation of from 800 to 1,000 feet above the sea-level. It was a dull, calm October day, and the hills on either side were cased in mist. Where I was no rain was falling and the ground was quite dry. As I passed on the road entered and traversed a wood of fir trees. Here I at once encountered a gentle drizzle. Far from suspecting that the trees were playing any part in the matter, I concluded that the expected wet weather had at last set in. When the road emerged from the wood at its opposite extremity I found that no rain was there falling or had fallen. Still I did not connect the trees with the downfall, but imagined that the weather had again improved. On returning from my destination about three hours afterwards I found that the rain was still falling in the wood, but that it ceased as soon as I emerged into the open country. The ground, too, within the wood was wet, still all around it was dry. Hence it appeared that a slight rain must have been falling for the greater part of the day within the wood, but not in the bare fields and heath land outside.

Thus under certain conditions of the weather the presence of trees may determine rainfall which would not take place in their absence. J. W. SLATER.

London, England.

Mineral Wax.

I notice an account and inquiry in *Science* of June 16 in regard to the receipt at the National Museum of specimens of natural wax coming from Portland, Oregon, derived from the shores of the Columbia River, and from other accounts it is found along the coast from the Columbia River to Puget's Sound.

The material has been well known for the past half century as mineral wax, native paraffin, ozokerite and lastly as ozocerite, a hydro-carbon compound (hydrogen, 15 per cent; carbon, 85 per cent — variable); supposed to be derived from bituminous and lignite coal formation by infiltration and crystallization. It is generally found *in situ* in the neighborhood of coal and lignite beds and in the bituminous clays or shales.

The legend as to its being derived from a wreck is a most absurd one. It is a resinous wax in consistency and translucency, with structure sometimes foliated; color brown or yellowish-brown by transmitted light; leek green by reflected light; odor, aromatic, in specimens that I have examined, having the characteristics and feel of beeswax that had been lying for some time in water.

It is mined in variable quantities in Germany, Austria, Turkey, and England, associated with the soft coal and lignite beds.

In Galicia alone about 30,000 tons have been mined since its discovery there in 1859. It is used in Europe principally in the manufacture of candles and by refining in place of beeswax and paraffin. It is said to be an excellent electrical insulator.

In the United States it is mined *in situ* at Soldiers Summit, Uintah County, and in Emery County, Utah. Sixty-five thousand pounds were marketed in 1888, with a yearly increasing output. The whole product of the United States in 1890, including the Oregon find, reached 350,000 pounds.

The imports of mineral wax, ozocerite, under the names of bay or myrtle, Brazilian and Chinese wax, in 1890 were over one and a half million pounds.

It has been found *in situ* in thin seams in the lignite beds of Oregon, Washington, and British Columbia. The deposits along the Columbia River and on the sea-shore of Oregon are no doubt the debris from lignite beds near by. C. D. HISCOX.

361 Broadway, New York.

BOOK-REVIEWS.

The Seismological Journal of Japan. Edited by JOHN MILNE, F.R.S.

IN 1880 the Seismological Society of Japan was founded by a number of earnest students of seismology in that country, prominent amongst whom was the editor of this Journal. In the earlier years of its existence its membership included such well-known names as Milne, Gray, Ewing, Mendenhall and others at that time resident in Japan, and their interest in the science led especially to the invention of many instrumental appliances for the study of earthquake phenomena, some of which have been copied wherever earthquakes are observed, and in some respects have revolutionized the science of experimental seismology. It also resulted in the establishment of a chair of seismology in the Imperial University of Japan, and the organization of a bureau controlling a central observatory and some 700 outside stations. Of late years, however, the interest in the society has declined, partly through the return of some of its most active supporters to England and America, and, after publishing sixteen volumes of Transactions, in 1892 the society ceased to exist. Professor Milne, however, still remains in Japan and has determined to continue the publication of seismological literature in the present journal, which is therefore to be regarded, not as an entirely new venture, but as a continuation of the series heretofore known as the Transactions of the Seismological Society. The new journal is issued in the same form and from the same printers as the old Transactions, and the first number, now at hand, bears on its title page Vol. XVII, which is its number in the old series, so that the new volumes can be bound uniformly with those previously issued. The annual subscription is five dollars.

In this number the first article is on ' The Mitigation of Earthquake Effects and Certain Experiments in Earth Physics" by Professor Milne, in which various lines of experiment are proposed that might possibly lead to the prediction of severe earthquakes so as to guard against their effects. In the second, "On the Application of Photography to Seismology and Volcanic Phenomena," Professor W. K Burton describes with illustrations the photographic records from Milne's t emor indicators. In the third Professor Milne gives an abstract of the "Seismometrical Observations for the Year 1890," from which it appears that in that year 845 earthquakes were felt in Japan, of which 49 were classed as severe, 264 as moderate and 532 as feeble. Of the severe earthquakes, four (Jan. 7, Mar. 19, Apr. 16, Nov. 17) were accorded more detailed description. In the fourth article "On the Overturning and Fracturing of Brick and other Columns, by Horizontally Applied Motion," Professor Milne and F. Omori describe a very interesting series of experiments, wherein various objects such as blocks of wood of different dimensions, bricks, columns built of brick or of cement, were mounted on a wheeled truck to which a reciprocating horizontal motion could be communicated, and the circumstances of the motion, with the overturning or fracture of the object, were electrically recorded. From the data the maximum velocity and maximum accelleration necessary for overturning were calculated and compared with the experimental results with a fairly good agreement. In an article on "Earth Pulsations in Regard to Certain Natural Phenomena and Physical Investigations," Professor Milne concludes that "the movements called earth tremors are movements in the crust of the earth not altogether unlike the swell upon the ocean," and infers a connection between them and the steepness of the barometric gradient. In an article "On the Movements of Horizontal Pendulums," he gives an abstract with notes of certain observations made by Dr. E. von Rebeur-Paschwitz at Potsdam, Wilhelmshaven and Teneriffe, and published in the *Astronomische Nachrichten.* F. Omori gives "A Note on Old Chinese Earthquakes," and as the concluding article Professor Milne gives a twenty-page "Note on the Great Earthquake of October 28, 1891," the phenomena of which are further discussed in his report to the British Association, 1892, and the complete account of which is to be issued under the auspices of the Imperial University of Japan, but is not yet ready for publication. According to the statements of this account the killed numbered 9,960, wounded 19,994, and houses totally destroyed 128,750. The immediate cause of the disaster was the formation of a fault which can be traced on the surface of the earth for a distance of between forty and fifty miles, and shows a difference of level amounting in many places to twenty or thirty feet. There is also abundant evidence of horizontal displacements, sometimes as great as eighteen feet, and the whole Neo Valley appears to have suffered a permanent compression, becoming narrower, the piers of bridges being left closer together than before the earthquake. There were also many observations of surface waves in the earth, involving a perceptible tilting of objects resting upon it; and the maximum horizontal motion indicated by the instruments was from 25 mm to 35 mm. with a period of from 1 to 2.5 seconds.

Notions de Chimie Agricole. Par TH. SCHLOESING, FILS. Paris, Gauthier-Villars et fils. Quai des Grands-Augustins, 55. 208 p. 8°. Broché, 2 fr 50. Cartonné 3 fr.

FOLLOWING in the footsteps of the elder Schloesing, M. Th. Schloesing, Fils, Ingenieur des Manufacteurs de l'Etat, presents us with an admirable treatise on agricultural chemistry covering in detail the physical and chemical relations of soil and atmosphere to plant life. Methods of chemical analysis are wisely left for a separate work and the results of analysis alone are given when a knowledge of the same is necessary to an understanding of the discussion. The nature of the experiments, however, and the manipulation of the same, are given with sufficient fullness to enable the reader to judge of the value of the conclusions. The general arrangement of the book is as follows: Part I. treats of the nutrition of plants, of germination, and of the origin of the organic and inorganic constituents. Part II. makes a study of the atmosphere in its relation to plant life and of the gases influencing this life, of nitrogen, oxygen, carbonic acid, nitric acid, ammonia, etc. Part III. treats of soils, their formation and composition, and of their physical and chemical properties. A bibliography, coinciding with the arrangement of the text, completes the work.

The author is particularly interesting in his section on nitrification and also in treating of the assimilation of free atmospheric nitrogen by plants and soils. The experiments and conclusions of Berthelot and André are noted as well as those of M. Schloesing, the author concluding with; "Il n'entre pas dans notre programme d'insister davantage sur ces diverses recherches; car nous tentons d'ordinaire à n'avancer que des faits positifs. Ici il ne nous est guère permis de faire un choix entre les opinions produites. Il est à espérer qu'un prochaine avenir levera les doutes qui règnent encore sur ce grave sujet."

The book has the usual exquisite neatness of first-class French publications, with full-bodied paper, clear print and broad margins, making it altogether a most enjoyable volume.

CHARLES PLATT.

Outlines of Forestry, or the Elementary Principles Underlying the Science of Forestry. By EDWIN J. HOUSTON. Philadelphia, J. B. Lippincott Co. 254 p. 12°. $1.

THIS little book is a useful manual of facts relating to the subject. Among the matters considered are the conditions necessary for the growth of plants, distribution over the earth, formation of soil, animate and inanimate enemies of the forest, vapor, rain, drainage, climate, hail, reforestation and tree planting, etc. The last chapter, called "Primer of primers," contains in short, concise sentences the substance of what had been given at length in the earlier chapters. Taken by itself, it would serve a useful purpose in the education of the general public to the importance of the subject.

The book is, perhaps, unfortunately written in a loose and rather slovenly manner. It abounds in repetitions of not only the same ideas, but also of nearly identical words. The following extracts are particularly bad examples, but they fairly represent the ordinary style of the writer: "Heat and light are to be found in practically all parts of the earth. They differ, however, in amount in different regions of the earth, and such differences cause the differences that are noticed in the plants that grow in different regions" "The quantity of moisture in the air differs greatly in different parts of the earth, and on this difference, together with the difference in temperature, depends the differences observed in the plants of various regions." "Each section of the country possesses, so to speak, a nationality in its plants, or, in other words, there lives in each section of country a particular nation of plants. Such a nation of plants, or the plants peculiar to a particular section of country, is called its flora."

The author makes use of a new word, "heatshine," which is rather difficult to define. "The sunshine and the heatshine which awaken the sleeping germ and call it into activity," etc. In the appendix are given various lists of trees suitable for planting, and these contain some curious errors. For example, under the head of "deciduous trees" we find maples, hickories, cedars firs and pines, while under "evergreens" are placed spruce, larch, sweet gum, poplar, oak, walnut, etc. In another place we observe under "conifers" bald cypress, red cedar, white pine, black cherry and European alder, while the European larch figures in another table as an evergreeen. Errors of this kind rather detract from the value of the book.

JOSEPH F. JAMES.

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Walker Prizes in Natural History.

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

1. The relations of inflorescence to cross-fertilization illustrated by the plants of Eastern Massachusetts.

2. What depths of formerly overlying rocks, now removed by denudation, may be inferred from the structure of various rocks in Eastern Massachusetts?

3. Experiments affording evidence for or against the theory of evolution.

Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed by a motto corresponding to one borne by the manuscript, and must be handed to the Secretary on or before April 1, 1894.

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

SAMUEL HENSHAW, Secretary.

Boston, July 3, 1893.

NEW METHOD OF PROTECTING BUILDINGS FROM LIGHTNING.

SPARE THE ROD AND SPOIL THE HOUSE!

Lightning Destroys. Shall it be Your House or a Pound of Copper?

PROTECTION FROM LIGHTNING.

What is the Problem?

IN seeking a means of protection from lightning-discharges, we have in view two objects,—the one the prevention of damage to buildings, and the other the prevention of injury to life. In order to destroy a building in whole or in part, it is necessary that work should be done; that is, as physicists express it, energy is required. Just before the lightning-discharge takes place, the energy capable of doing the damage which we seek to prevent exists in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider in this place; but that it exists there can be no doubt, as it manifests itself in the destruction of buildings. The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life.

Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall aid in this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved.

A Typical Case of the Action of a Small Conductor.

Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

One hundred feet of the Hodges Patent Lightning Dispeller (made under patents of N. D. C. Hodges, Editor of *Science*) will be mailed, postpaid, to any address, on receipt of five dollars ($5).

Correspondence solicited. Agents wanted.

AMERICAN LIGHTNING PROTECTION CO.,

874 Broadway, New York City.

SCIENCE

NEW YORK, JULY 21, 1893.

THE SOUTH DAKOTA ARTESIAN BASIN.

BY W. S. HALL, M.S., M.D., HAVERFORD COLLEGE, HAVERFORD, PA.

THE State of South Dakota is about 320 miles long by 210 miles wide. The Missouri River crosses the middle of the north boundary and flows south-southeast till it reaches the north boundary of Nebraska, when it sweeps around to the east and forms the boundary line between South Dakota and Nebraska. Five great water-courses pass down the long slope of the high plains from the western boundary of the State to the Missouri River. The largest of these is the Cheyenne River, furnishing a drainage channel for the Black Hills, which lie partly in South Dakota and partly in Wyoming. A few small, short streams flow from the east into the Missouri. The James River (formerly called Dakota River) flows in a very direct course, south by east, across the State, bisecting the part of the State east of the Missouri River. The James River valley is a broad plain fron 1,200 feet to 1,300 feet above sea-level. As early as 1882 artesian wells were drilled at different places in the valley with the hope of securing a more abundant supply for the cities and villages which were so rapidly outgrowing their water-supply.

The uniform success in getting water, the abundant supply, the good quality, and the great force with which it was ejected began to attract general attention. It has been demonstrated by numerous and widely-distributed experiments that the whole James River valley is an artesian basin. Geologists and engineers seem to agree that it is the most wonderful artesian basin in the world. The source and limit of the water-supply of this region have been the subject of careful and extended investigations by both Federal and State commissions. In this brief paper the writer will endeavor to give the results of these investigations to date.

1. The source of the supply of water.

There are three general requirements that must be satisfied in seeking for the source of supply of an artesian basin :—

I. The source must be as high as the greatest height to which the water, in any well tapping the basin, will rise.

II. The amount of rainfall on the source-area must be adequate to account for the supply of the basin.

III. The geological formations between the source and the basin must be such as to allow the passage of the water through a pervious stratum between two impervious strata.

Several theories exist as to the source of the supply in the basin in question : (*a*) The Great Lakes ; (*b*) the Canadian lakes ; (*c*) Devil's Lake, North Dakota; (*d*) the Missouri River; (*e*) the elevated region west of the Missouri River, including the foot-hills and the east slope of the Rocky Mountains.

Let us apply the three requirements stated above to the regions just named.

The height to which the water of the Redfield, South Dakota, well would rise, if the tube were extended, is 1,700 feet A. T.[1] There are other wells north and west of Redfield whose water would rise to a greater height.[1] The well at Highmore has a flow of nine gallons and a pressure of twelve pounds at an altitude of 1,890 feet.[2] But the altitude of the Great Lakes and of the Canadian lakes is many hundred feet below that height.[3] The altitude of Devil's Lake is about 1,440 feet,[1] and the altitude of the Missouri River where it enters South Dakota is not over 1,500 feet.[3]

1 "Artesian and Underflow Investigation," Part II., Col. E. S. Nettleton, Chief Engineer. Appendices XVIII., XIX., and XX.

2 "Artesian and Underground Investigation," Part IV., F. B. Coffin, Engineer for South Dakota.

3 American Geological Railroad Guide. Macfarlane.

It therefore follows that neither the Great Lakes, the Canadian lakes, nor Devil's Lake can be the source. Nor can the Missouri River within the State be the source. We are now confined to our last alternative,—the elevated region west of the Missouri River,—which may, for convenience, be considered under two heads: (1) The High Plains, and (2) The Foot-Hills of the Rockies. (1) The high plains attain an altitude of 1,900 feet about 50 miles west of the Missouri River.[4] They satisfy requirement I.

An idea of the water-supply of an artesian basin can be gotten only by finding the amount of water that can be drawn off without lessening the flow and pressure of individual wells. W. P. Butler, engineer of Aberdeen, South Dakota, under date of June, 1892, says that "two hundred wells have already been put down in North and South Dakota."[5] The same engineer gives a "Table of twenty-four South Dakota wells showing flow in gallons per minute."[6] The range of discharge, as shown by this table, is from 150 gallons to 7,000 gallons per minute; the intermediate points seem to be sufficiently represented to indicate that the table is fairly representative. Taking this table as a basis, the average flow of a South Dakota artesian well is 1,655 gallons per minute. Two hundred wells would, at that rate, discharge 685 million tons per annum. No diminution in the pressure of any of the wells has been detected. The limit has, therefore, not yet been approached. Now many times the amount annually discharged by the South Dakota artesian wells falls each year upon the high plains (region *e*, 1) west of the Missouri River in South Dakota ; but the rapid evaporation from the surface, the ready drainage into the Missouri River, and the impervious shales beneath the surface preclude the possibility of the high-plain rainfall taking any appreciable part in the water-supply of the basin. Driven now to our last alternative, let us apply our three tests in succession.

I. The elevation of the foot-hills varies from 3,000 feet to 8,000 feet above sea-level, which is certainly sufficient altitude above the James River valley to overcome the resistance and give the wells a high pressure 240 to 600 miles away.

II. The annual rainfall in the foot-hills is greater per given area than on the high plains.[7]

The area of the foot-hills, whose rainfall can get access to the water-bearing rocks, is not far from 40,000 square miles, upon which area not less than 69,600 million tons of water fall per annum, which is one hundred times as much as that drawn annually from the artesian basin of the Dakotas.

III. The geological formation between the Black Hills and the James River valley is well shown by the accompanying figure.[8]

A glance at this figure will show that water entering the porous Dakota sandstone above Rapid City will produce the conditions for an artesian flow in the region of the James River and the Missouri River. The lower altitude of the former will make the flow stronger there, even though it be farther away from the source. The increasing altitude as one goes west from the Missouri River will undoubtedly decrease or wholly prevent a flow. Any geological section taken across the Dakotas from east to west would be similar to the one shown. Wherever the section would pass through foot-hills or mountain ranges the upturned edges of the absorbing strata would crop out.

The three requirements being satisfied by the last region tested, it has been demonstrated beyond a shadow of doubt that the source of the water-supply of the James River artesian basin is

4 "Artesian and Underflow Investigation," Part IV., F. B. Coffin.

5 Irrigation Manual. W. P. B. p. 9.

6 Irrigation Manual. W. P. B. p. 38

7 Irrigation Manual, W. P. Butler, p. 94, "On the high plain the rainfall is 15 to 20 inches, while in the Black Hills it is 20 to 30 inches per annum."

8 "Irrigation and Underflow Investigation," Part III., Special Report by Professor G. E. Culver, State Geologist.

the elevated, well-watered hills and low mountains, together with the east slope of the Rockies in South Dakota, Montana, and Wyoming.

2. The limitations of the supply.

It was estimated that about 69,600 million tons of water fall annually on the foot-hills within this drainage basin. Having limited the source to the foot-hills, it is clear that the limitations can be carried further. The water flowing through the Dakota sandstone must either (*a*) have fallen directly upon the area of outcrop, or (*b*) have sunk into it from streams flowing over it, or (*c*) have escaped into it at high altitudes from other strata.

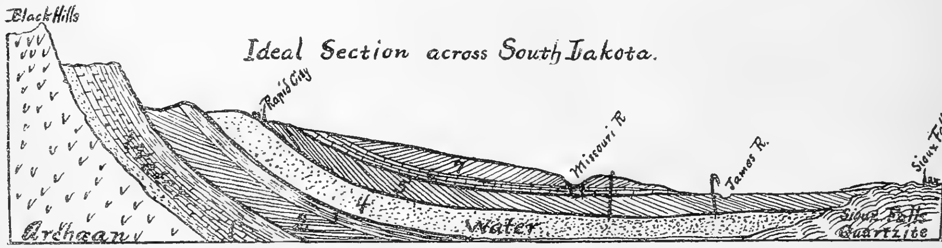
(*a*) It is estimated by Professor G. E. Culver[1] that about $\frac{1}{72}$ of the rainfall of the Black Hills falls directly upon the outcropping Dakota sandstone. If this outcrop forms the same proportion of other foot-hills, then about 966 million tons per annum would fall directly upon this; and, as it is estimated that one-third of the rain-fall is absorbed by the soil, 322 million tons would be poured directly into the artesian basin.

(*b*) As far as the writer knows, but one stream has been carefully studied as to the quantity of water lost to the stratum in question. Below Great Falls, Montana, the Missouri River flows across the outcropping Dakota sandstone at an altitude of 2,800 feet. Col. E. S. Nettleton[2] made careful gaugings of the river before and after crossing the sandstone and found that it lost "834 cubic feet per second," which would amount to 918 million tons per annum. The Yellowstone River, which is about as large as the Missouri above their confluence, is said to flow across the Dakota sandstone and to lose a part of its volume. It is generally true that all streams flowing out of the foot-hills or away from the Rockies must, somewhere in their eastward course, cross the absorbing stratum. To estimate three times 918 million tons as the amount received from source (*b*) will probably fall much within the limits. That gives us an aggregate from (*a*) and (*b*) of 3,076 million tons per annum.

(*c*) The outcrop of the Carboniferous forms a much larger part of the foot-hills area than does the Dakota. At least one-third of the water which falls directly upon it sinks, while nearly all of the small streams flowing out of the central Archæan area of the hills sink completely into the Carboniferous, only a few of the largest streams emerge from the thirsty Carboniferous area. The amount of water entering the Carboniferous strata is many times greater than that entering the Dakota. Now it is possible for nearly all of the water which it absorbs to escape into the Dakota, which it would do anywhere between its source and the James River valley if either one of two things were true: (1) If the overlying stratum "pinches out," or (2) if it is fractured or faulted. Both, one, or neither of these things may be true. No one has yet attempted to answer, conclusively, the question, "What becomes of the water which sinks into the Carboniferous limestone of the hills?" Until that question is answered, it will be impossible to determine the limitations of the water-supply of the artesian basin.

[1] "Artesian and Underflow Investigation," Part III., p. 207.

[2] "Artesian and Underflow Investigation," Part II., p. 77.



Length of Section, 385 miles. Rapid City to James River Valley, 230 miles.

1, Paleozoic rocks, mostly water-bearing Carboniferous limestone; 2, Triassic shales, impervious; 3, Jurassic shales, impervious; 4, Cretaceous, Dakota sandstone, water-bearing; 5, Cretaceous, Benton shales, impervious; 6, Cretaceous, Niobrara limestone; 7, Cretaceous, Pierre shales, impervious.

A ROW OF HIEROGLYPHS, CASA NO. 2, PALENQUE.

BY H. T. CRESSON, A.M., M.D., PHILADELPHIA, PA.

THERE is a perpendicular row of three glyphs just above the child-like figure, upheld in the arms of the *Ahkin* (?), on the centre slab of the so-called "Group of the Cross," Casa No. 2, (Stephens), Palenque, and two hieroglyphs in the parallel line to the right of the perpendicular line just mentioned, which are exceedingly interesting, and all of them, except the upper-centre component of the glyph, just above the child-like figure, are in a fair state of preservation. The upper centre component of this glyph (Fig. 6) has been badly injured, if we may judge by a photograph of the slab from Casa No. 2, taken by Dr. Manuel Urbino, the learned conservator of the Muséo Nacional, at the City of Mexico. It is a lucky circumstance that this masterpiece of the Maya scribe-sculptor's art has been cared for by the Mexican government, and it is to be hoped that they will protect other tablets at Palenque from the wanton destruction of the Mayas, who have been accused, by recent explorers, of chopping to pieces, with their *machetes*, the artistic productions of their ancestors.

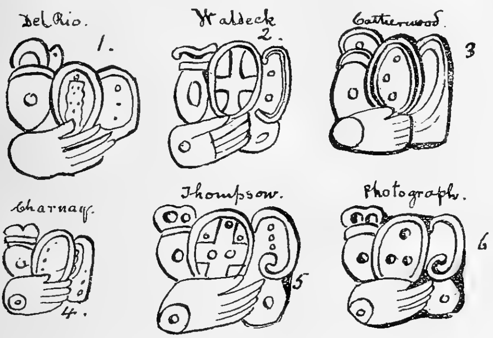
It will be impossible, in this necessarily brief article, to consider the entire row of glyphs which have been indicated, we will, therefore, confine our remarks to that shown in Fig. 6 of the plate. If we compare this sketch, made from a photograph of the middle slab of the cross group (Casa No. 2, Palenque), taken by Dr. Urbino, it will be seen that it differs in certain respects from the drawing of Del Rio, Waldeck, Catherwood, and Charnay. Del Rio's rendition of this hieroglyph (Fig. 1) is absurdly incorrect, and has been suggested, we think, either by a slovenly impression of the centre bar of a cross (see Waldeck's Fig. 2), or else the artist drew upon his imagination and supplied the detail.

Waldeck's drawing (Fig. 2) in four of the small glyphs (composing the compound glyph) is not so far astray as one might expect, judging by the way his drawings have been condemned by some writers, and I find that in the perpendicular and the parallel row of glyphs of the Casa No. 2 tablet, to the right of the symbol of the days, four winds, and cardinal points (called by many the Cross), his work compares quite as well with the photograph as that of Charnay, who used the camera, and Catherwood, who used the camera lucida. So far as I can learn, Mr. Waldeck used no artificial aids to assist him in his work (?); if this be the case, his eye must have been an unusually correct one, considering the amount of work he accomplished, and the confusing details that he encountered, to say nothing of annoyances in the way of flies, mosquitoes, garapatas, and other insects. I think the truth of this assertion will be apparent to anyone who has attempted to make a careful drawing under difficulties of this kind, especially such intricate details as we find in ancient Maya architecture and hieroglyphs, well calculated to give an experienced draftsman the headache and heartache. The centre-upper component of the hieroglyph, drawn by Waldeck, differs from that of Fig. 6, but I must not neglect to mention that the Urbino photograph indicates that this component of the glyph has been so injured that it is difficult, at present, to determine the details. The round incisions are apparent, as in Fig. 6, but they differ slightly in their position when compared with Catherwood (Fig. 3).

Stephens mentions that, at times, those engaged in commercial ventures have reached Santo Domingo del Palenque, and proceeded thence to the ancient Maya ruins, called, for want of a better name, Palenque, after the village near which they stand.

We have represented in Fig. 5 a sketch made by Mr. William Robert Thompson, who visited the ruins of Palenque in December, 1852, and again at a later date. Engaged in commercial pursuits in northern Chiapas and other parts of Mexico and Guatemala, Mr. Thompson has examined many of the old Maya cities, especially Qurigia and Palenque, sketching, in leisure moments, such details as he found interesting, preserving them for his own gratification. In looking over his portfolio some years ago I was struck with the resemblance of his drawing (Fig. 5) to that of Waldeck (Fig. 2). Mr. Thompson having returned to Mexico, I wrote to him in 1882 requesting a copy of his sketch, and, with all due courtesy, he presented me with the original, accompanying it with an autograph letter. The letter and sketch I shall forward to the American Philosophical Society of Philadelphia, so that they can be preserved for future examination.

Comparing the Thompson sketch with that of Mr. Waldeck, it will be seen that the latter has omitted the small incised circles which are present in the former, on the bar of the cross and at its top and sides, which Mr. Thompson's letter especially mentions as present. Waldeck, in the cross-like glyph, to the right, gives



two small circles as its components, and Thompson gives three, which Charnay also indicates in Fig. 5, while both he and Catherwood omit the small round glyph with the incised circle, which is shown at the lower right-hand side in the Urbino photograph (Fig. 6), also in the sketches of Waldeck and Thompson. It is not surprising that so careful a draftsman as Catherwood should have omitted details in drawing this glyph, ill as he was with fever and subjected to annoyances which only those who have encountered them can appreciate.

All of the drawings of this (Fig. 6) glyph differ more or less; those of Waldeck and Thompson have four of the small glyphs represented with a fair degree of exactitude, accepting the photograph as our standard; Catherwood and Charnay have three details of the compound glyph which are, in a measure, correct. The fact that Messrs. Waldeck and Thompson both give a symbol resembling the symbol of the cardinal points as a component of the glyph which we are considering, suggests a probability that it existed and has been effaced. The surface of the glyph at present being so mutilated it would be best to examine the original tablet with care before deciding the matter, which I hope someone interested in palæography will have the opportunity of doing in the near future. The position of the three small circles in Fig. 6 correspond with the Thompson sketch (Fig. 5), even if the cross is absent, and, as Thompson gives an incised circle to either side of the cross at the top, it is not improbable that a series of dotted lines, or circles, at one time ran completely around the glyph, as we see a slight suggestion of this in Charnay's sketch (Fig. 4), and also in Catherwood's Fig. 3. Mr. Thompson asserts, positively, in his letter, that a cross did exist, and that the three incised circles were present on its perpendicular and parallel bars. He has, in a recent conversation upon the subject, expressed the belief that this symbol of the winds has been mutilated intentionally, and that the two circles at the sides of the perpendicular bar are quite recent additions, made by someone trying to alter the glyph into the semblance of a face. Two small circles on either side suggest the eyes, and the upper portion of the perpendicular upright above being mutilated across, just beyond its point of junction with the parallel bar, thus produces a semblance to a nose, the parallel bar assuming somewhat the appearance of a mouth. This seems to be the case in the small Urbino photograph, but in the enlarged copy the mutilation of the glyph is more apparent, yet, as we have suggested, these matters can only be decided upon by a careful study of the original tablet.

A realistic drawing of the upper-centre component of this hieroglyph would be of great value for comparison with the photograph, as there are some details which the camera does not reproduce. If some of our artists visiting the Muséo Nacional, at the City of Mexico, would make a careful drawing of the Casa No. 2 tablet, it would be of great value to those engaged in the study of Maya palæography, and no doubt determine the question whether a cross and its dots (Fig. 5) are to be accepted as the true components of the glyph, or the details given in Fig. 6 of the plate accompanying this article. Until these doubts be settled, attempts at its interpretation are useless.

THE OSAGE RIVER AND ITS MEANDERS.

BY ARTHUR WINSLOW, OFFICE OF THE GEOLOGICAL SURVEY, JEFFERSON CITY, MO.

IN the remarks upon the Osage River in Missouri, which form part of his admirable notice of the topographic maps of the U. S. Geological Survey, published in *Science* of April 28, 1893, Professor Davis has, with great acumen, hit upon one of the most noticeable features of the drainage of the State, or, at least, of the southern part. The peculiar meandering of the deeply trenched Osage Valley around spurs of high upland country, as referred to by us in a recent report of the Geological Survey,[1] is a feature shared by nearly all of the principal streams of the Ozark region. The Meramec and the Gasconade Rivers, the Big Piney and the Bourbeuse Creeks of the northern slope have the same swinging course; as have also their tributaries and those of the Osage itself. White River, on the southern slope, in Missouri and Arkansas, is characterized by similar convolutions. The courses of Big River and of the St. Francois River in the southeast have a like aspect. In strong contrast to this are the streams of that portion of the State lying north of the Missouri River—the drift-covered area. Here the courses are, in a general way, straight, often parallel in groups, the meanders of the streams confined to their present flood plains; their channels apparently having originated in the mantle of glacial drift. They are comparatively of recent origin, the older drainage system which lies masked beneath the drift may have been more tortuous.

The suggestive explanation which Professor Davis offers for the sunken curved course of the Osage, i.e., that it has been developed, through elevation and corrosion, from the flood-plain meanders of the stream, originating during an earlier base-leveled condition of the country, seems a natural explanation and is in many respects satisfactory. Still we hesitate to accept it in the present stage of our knowledge on mere *a priori* grounds. We see that it calls for a previous base-leveling of the whole Missouri-Ozark region, if not of the contiguous or even remoter Arkansas territory. Further, the hypothesis has so intimate a bearing upon the problems of recent geologic history of this country, over and above its relation to the development of the topography, that we wish to see full test made of its sufficiency before we adopt it as an axiom.

According to the best light we have at present, we recognize that the Ozark area was uplifted in late Cambrian times and remained above water level, in part at least, probably until the carboniferous period; that, if entirely submerged during the Mississippian epoch, it was so only long enough to receive but a

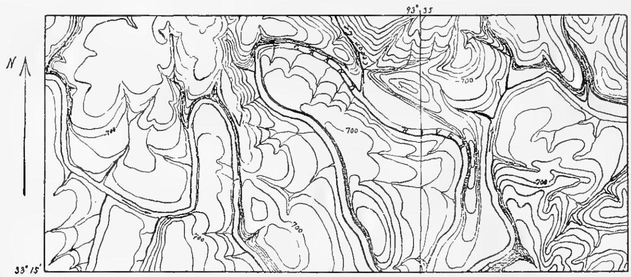
[1] "Report on Iron Ores," vol. ii, p. 89.

thin covering of the rocks of that formation; that these rocks were subjected to subareal erosion before and probably during the Pennsylvanian epoch and that coal-measure strata probably never covered the dome of the uplift; that since this time the region has been continuously above water level. According to this record the sculpturing of the topography must have been uninterruptedly in progress from the end of the Paleozoic to the present time.

Professor Davis sees evidence in the character of the relief that denudation progressed to such a degree that the present upland was a lowland—" well into Tertiary time, and that the new trenches of the Osage and its neighbors were begun in consequence of an uplift somewhere about the close of Tertiary time" —as opposed to this conclusion we have the fact that the Ozark plateau is at present much above the limits which we recognize Tertiary seas to have reached. The altitude of the Tertiary margin of the Mississippi embayment in southeastern Missouri is under 400 feet A. T. The summit of the Ozarks is, however, as much as 1,700 feet above sea level and the greater portion of the upland is over 1,000 feet, and was consequently at least 600 feet above the Tertiary sea level. Could a country having this altitude above contiguous seas be in a base-leveled condition? Further, another fact to reconcile with this hypothesis is the finding of certain chert gravels fringing the Osage and other valleys of the Ozarks, not very high above the present channels of the streams, which we provisionally correlate with the Orange sands of the Mississippi, of probable late Tertiary age. These imply the existence of such valleys with approximately their present phases in late Tertiary times. Still, as the correlation of these gravels is as yet confessedly quite hypothetical, this consideration cannot claim much weight.

Another hypothesis which has been thought by us to suggest an explanation of the sinuosities of these streams, has gained some strength through the observations of a recent boat trip down the Osage River, from Osceola to its mouth. If we take the case of a stream with a slightly sinuous course and of considerable declivity, moderately incised in a nearly flat, or even in an undulating country of horizontal strata—such as might exist in a newly emerged land surface soon after its emergence—we can understand that meanders will tend to develop somewhat as they do in the alluvial plain of a stream which has reached base level. Where the current impinges sapping will increase the convexity and the sinuosities will become more pronounced Inasmuch, however, as the declivity of the stream is great, corrosion is still active and the channel thus sinks vertically at the same time that it moves laterally, and in this respect its development will differ from that of a channel in a base-leveled alluvial plain. As a natural result of this process we can see how the stream will eventually shape for itself a tortuous and steep-sided valley, with very narrow flood plains until the channel has reached base level, when corrosion will cease and lateral degradation will increase; then, swinging from bluff to bluff in a secondary system of sinuosities, the stream will sap its bordering hills and widen its flood plains. If this explanation be a true one we should expect certain peculiar features of topography to prevail. Thus, with a stream not yet at base level we should look for its channel to constantly hug the hill on that side of the stream which is impinged by the current; here we should expect to find bluffs developed and maintained; conversely, on the "lee" side of the stream, we should expect to find such flat alluvial plains as exist, with comparatively gentle slopes thence to the uplands. Further we should expect to find the points or promontories of uplands which are nearly surrounded by the loops of the river, sloping somewhat gradually towards their ends and not terminating in bluffs. These features are pronounced, in part at least, to a striking degree along the Osage. They are details which could not be brought out on the maps of the scale of those thus far made of the Osage country, but the constancy with which the stream clung to the bluffs on the impinging side was impressively seen during the recent trip along that river, while the form of the projecting uplands is well illustrated by the following copy of a portion of a map of Grand River, one of the tributaries of the Osage, recently surveyed by Mr. C. F. Marbut, of the Missouri Geological Survey. On the hypothesis advanced the precipitous slopes characterizing the upstream sides of the hills here shown are the result of the sapping action of the stream; the gradual slopes of the downstream sides are primarily a combined result of the lateral movement of the channel accompanying the expansion of the meanders, and of its downward movement by corrosion.

It is true that similar features would result with the trench of previously developed meanders in the manner suggested by Professor Davis; for we cannot conceive of a meandering channel sinking absolutely vertically. Lateral degradation and movement must always accompany corrosion and vertical lowering of the channel; if the meanders existed originally their shapes must have been modified to the present forms. Hence the effects cited would seem to be attributable to one of two causes, or to both combined. The question is whether one is not all sufficient; whether a previous base-leveled condition is a necessary assumption.



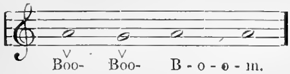
Scale, 1 mile to 1 inch. *Contour-interval, 20 feet.*

MEANDERS OF GRAND RIVER, A TRIBUTARY OF THE OSAGE.

THE BOOM OF THE PRAIRIE CHICKEN.

BY T. A. BEREMAN, MOUNT PLEASANT, IOWA.

How many of your readers ever saw a prairie hen, or, as they are commonly called in the west, the "prairie chicken?" Doubtless many have seen dead ones, killed and shipped for the market, but I dare say that many of your younger readers, especially those living in the cities and towns, have rarely seen a live one. In 1845, when I came to Iowa, and for several years afterwards, they could be seen here in flocks of thousands together. But now there are only a few remnants of them left; here and there, in isolated fields, some dozen or two survivals have been permitted to remain. They are what is called the pinnated grouse of North America, and were formerly inhabitants of New Jersey, Pennsylvania and Kentucky, and all the western prairie country.

But at present I only desire to call attention to the matinee songs of this wild bird of the prairie. Some morning in the month of April, when the sun rises clear and the air is crisp and frosty, go out upon the suburbs of a prairie town, away from the usual noises of the village, and listen. In a few seconds, if you can recognize the sound, you will hear, above everything else, the male birds go "boom, boom, boom." This is not a sharp, shrill cry, but a round, full, detonating cannon-like sound, which may be heard at long distances. It comprises three clear, distinct musical notes, corresponding with the "do, si, do" of the diatonic scale. The first two are quarter notes, and the last is drawn out to a full note, and even a prolongation of that. Probably some idea of it could be had from this representation:

This "booming" may be heard every spring along in March and April, and sometimes till May on clear frosty mornings about sunrise and for an hour or two afterwards; and for that reason I have sometimes from my own fancy called them "sun worshippers." It is worth an hour's walk to go out and see these birds when engaged in their booming orizons. As I have heard thousands of them booming at one time along in the forties and fifties, and have cautiously crept up to within a few yards of them when they were in plain view, let me try and describe them if possible.

The males have two neck tufts of feathers, two or three inches long, one behind each ear, and ordinarily they lie down close to the neck. Also on the sides of the neck and extending about two-thirds of the length of it, are two bare patches of skin capable of being inflated with air until they show out on either side as large as a small orange, and are nearly the color of an orange. Now, the proceeding is something like this: The bird stands unconcernedly among his companions for a minute or so, and then suddenly he spreads his tail to its fullest extent like a fan; his wings are spread and thrust down to the ground similar to a turkey gobbler's action; he walks around and about, rubbing his wing feathers upon the ground, his feet go patting alternately so rapidly you cannot count the motions, his head and neck thrust forward horizontally, the two tufts of feathers are erected like two great horns, the bare skins on the sides of the neck are inflated and then comes "boom, boom, b—o—o—m." This is repeated every few minutes for one or two hours in the morning, when no more is heard until near sundown in the evening.

A SILK-SPINNING CAVE LARVA.

BY H. GARMAN, LEXINGTON, KENTUCKY.

In the Bulletin of the Essex Institute, Vol. XIII., 1891, I described a singular larva from Mammoth Cave, which was compared with larvæ of the Dipterous genera Sciara and Chironomous, to which it bears some resemblance. Since this larva was discovered a lookout has been kept for other specimens in hope of learning something of the adult, but thus far no additional examples have been seen. My search has been rewarded, however, by the discovery of a second larva, very different from the first but in its way almost as strange. Evidently it is a related insect. I take it to be the young of some cave-inhabiting fly.

Large examples measure 12.5 millimetres in length by 1 millimetre in greatest diameter. The body is composed of twelve somites behind the head, very distinct from each other and gradually increasing in diameter from the first to the seventh, after which they remain constant to the twelfth, which is only about one-half the length of the preceding somite and not more than one-fourth its size. The head is very small, and is enclosed in a smooth and shining crust of a pale yellowish brown color. The body terminates in a double finger-like clasping organ.

On a visit to a small cave near Lexington, Kentucky, some months ago my eye was caught by a glistening thread on the limestone forming the side wall of the cavity, about four feet from the floor. Thinking it was the trail left by a spider, I began to follow it carefully, expecting by this means to come upon the insect. Instead of a spider this larva was found,—a translucent slender thing which might easily have been overlooked even when one was engaged in following the thread upon which it lived. A touch was sufficient to put it in motion, then a touch at the opposite extremity would cause it to move backward with equal address. But nothing would induce it to leave the thread, and I have since learned that the heat from a burning candle applied to its body and destroying its life leaves it clinging to this fragile object. Not even spiders show such tenacity in retaining possession of their egg-cases, or webs, when in danger, and I infer that the welfare of this larva is intimately associated in some way with the silken path it makes along the face of the rocks. The thread is always accupied by a single individual, and may be a foot or more in length. I have found no examples nearer the floor than three feet.

The larva clings to its thread by means of pads provided with very minute chitinous asperities. One such pad occurs at the anterior ventral margin of the second, and another in the same position on the third, som te. These form rather large transverse rounded folds of the skin, covered posteriorly with dark denticles in numerous short series. The fourth somite lacks the pad, but on the ventral side and anterior margin of each of the succeeding divisions is a pad of another form, these being broader but not extending so far up the sides. When creeping an undulatory motion passes along the body, the pads dragging it forward, the posterior appendage apparently aiding by seizing the thread.

The details of structure have not been thoroughly worked out. In a general way the head is like that of the larva described in the Bulletin in 1891, but the large ocellus-like smooth areas of the Mammoth Cave larva are not present in this, although I find smaller oval areas surrounded by black rims and accompanied by pigment spots, which appear to represent these structures. The mouth parts are much like those of larval Sciara. The palpi which project from the under side of the head spring from the maxillæ. In very young examples I can make out large ducts which convey a secretion of some kind (doubtless the material of which the silken fiber is composed) to the under side of the head. No outward trace of respiratory organs is apparent. Four dark-brown Malpighian tubules can be seen, through the body-wall, opening independently into the intestine.

On the dorsal middle line near the anterior margin of each of the somites 8 and 9 is a turret-shaped prominence, the nature of which I have not determined. The top is sometimes a trifle impressed as if there were an opening to a gland beneath the skin. They can not be stigmatal prominences, for these are always paired. A study of sections may yield an explanation of them.

The habit of living upon the side walls of the cave is probably a means of avoiding enemies. Few of the predaceous cave species would find the larvæ there. The only available food would seem to be occasional tallow drippings and the molds growing on them.

Silk spinning is not general among Dipterous larvæ, but the cave species is not peculiar in this regard. I suspect that the Mammoth Cave larva produces a thread also. Among ordinary Diptera the clover midge (*Cecidomyia trifolii*) occurs to me at this moment as an example of species which produce material in the nature of silk. It envelops itself in a rather tough papery cocoon when ready for pupation.

A VERY bright comet has suddenly appeared in the western sky, and is attracting attention from the unexpected manner in which it has presented itself. The object from present accounts was first seen on the 8th inst., by persons living in Utah and Wyoming. It is very bright. about of the second or third magnitude, and has a tail that has been reported to be from five to twelve degrees in length. The comet is moving very rapidly to the east, and the only orbit at hand, at present, indicates that it is now passing away from the earth and will diminish very rapidly in brightness.

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

A NEW ORTHOGRAPHY.

BY J. I. D. HINDS, CUMBERLAND UNIVERSITY, LEBANON, TENN.

THE orthography of the English language is distressingly bad. A reform in spelling would relieve education of one of its heaviest burdens. The hardest task of the first six years of the child's school-life is the spelling lesson. Indeed, the labor never ends. The veteran school teacher dares not venture too far from his dictionary. None of the phonetic systems which have been presented have met with such favor as to pass into general use. Yet reform must be possible.

In the phonetic systems now before the world there are two barriers to their general adoption. In the first place, the change from the present spelling is too great and too abrupt. The human race is like a heavy body in motion. Change of direction must be effected gradually. In the second place, the proposed systems are too complicated, and present distinctions which are too nice to be generally appreciated. To be acceptable, a system must possess two leading characteristics: (1) It must make the least possible departure from that now in use, and (2) it must be so simple that it may be read at sight and that the little child can learn it understandingly.

I think such a system is within our reach and that it might be brought into general use in a few years. I suggest the following:—

1. The present alphabet should be retained with as little change as possible. This is important, because new characters frighten the people and lay additional burdens on the printer. Besides, the language can be very well written with the characters which we have. The only deficiency is found with the vowels, and this can be supplied, as I shall show later.

2. Each character should have a fixed sound, and should retain the same sound in all its positions. In carrying out this rule, too much nicety must not be attempted. The vowel sounds are so variable that to represent all of them we should have to multiply characters almost indefinitely. We should thus have many words spelled differently in different positions and as coming from the mouths of different speakers. Every word should have a fixed form, and should retain this form in all its positions, though its pronunciation should vary. The written word is the symbol of an idea, and, at best, but approximately represents the spoken word. What we want is a compromise between the two which will do the least violence to pronunciation and afford the greatest ease in spelling. The mind tolerates a certain amount of ambiguity rather than endure too nice distinctions. This is illustrated in the varying sounds of the vowels as now used. Again, obscure sounds cannot be well represented phonetically. In syllables where they occur the vowel indicated by the etymology of the word should be retained.

3. Words should be spelled as they are pronounced, and each sound should be represented by its proper character wherever it occurs. Here, as before, too much nicety must not be attempted. Let us have a judicious compromise. The great difficulty of English spelling does not depend upon the fact that each of the vowels has several sounds. It is rather because each of these sounds is represented, not only by the other vowels, but also by a wonderful variety of combinations of vowels and consonants. For example, the long sound of *a* is indicated in at least twenty different ways, as in the following words: Bass, f*a*te, p*ai*n, p*ay*, d*a*hlia, v*ei*n, th*ey*, gr*ea*t, *eh*, g*oa*l, g*au*ge, champ*a*gne, camp*aig*n, str*aigh*t, f*eig*n, *eigh*t, *aye*, ob*ey*ed, w*eigh*ed, h*al*fpenny. So there are twenty-four combinations expressing the long sound of *e*, twenty-six for the sound of *a* in all, among which are *augh* in aught, *ough* in thought, and *augha* in Vaughan; and for the sound of short unaccented *a* Miss Soames finds no less than thirty-four letters and combinations. No wonder the child, when learning to spell, is ready to give up in despair.

Now all that is very desirable can be attained through our present alphabet by giving to each letter a fixed sound and supplying a few vowel sounds by the use of double letters. The names of the letters should be so changed as to give to each vowel and vowel combination the sound which it represents and to make the names of the consonants uniform. We will take the five vowels and give them the names which they have in the European languages, and let them, when written singly, represent the short sound of these vowels. Let the long sounds be indicated by doubling or adding the letter *e*. For the diphthongs retain the ordinary combinations. The vowel system will then stand as follows:—

Vowels.

Long.	*Intermediate.*	*Short.*
aa, as in father,	*a*, as in last,	*a*, as in mat,
ae, as in mate,		*e*, as in net,
ie, as in machine,		*i*, as in mit,
oe, as in note,		*o*, as in not,
ue, as in rule,	*oo*, as in foot, bull,	*u*, as in up.

Diphthongs.

ei, like *i* in pine,	*ai*, as in air,	*oi*, as in boil,
au, as in laud,	*ou*, as in house,	*yu*, as in you.

Examining this table, we see that the short vowels present no change from their present usage. The Italian *a* is expressed by doubling the letter. The long *a* really corresponds to short *e*, and there is a fitness, therefore, in representing it by *ae*. This is commonly done now, except that the *e* usually goes to the end of the syllable. The other long sounds are also appropriately indicated by adding *e*. The intermediate *a* is so little used that it hardly seems necessary to provide for it a separate character. Its sound is usually suggested by the consonants which follow it. The sound of *u* in bull is well represented by *oo*. The long *u* is really *yu*, and it is so indicated. The least satisfactory of all, perhaps, is the use of *ei* for the long sound of *i*. The combination *ai* would have been better, but this occurs now in so many words and its sound is so well fixed that it was not thought best to change it. As a compromise, the letter *I* may still be retained for the personal pronoun. When these double vowels are once in use, they will naturally, in the course of time, be combined into one character.

Since the short vowel sounds do not occur in accented, open syllables, the lengthening *e* may be omitted in these, and the spelling thus further simplified. As an additional compromise, the letters in such positions might retain their present sounds.

With the consonants, we need have little trouble. We will obtain the name uniformly by adding to each letter and combination the long *a*. The sound being indicated by the name, it is not necessary to give sample words. With an approximate classification into surds and sonants, stops and continuants, they are as follows:—

Consonants.

p, pae,	*b*, bae,	*t*, tae,	*d*, dae,
f, fae,	*v*, vae,	*k*, kae,	*g*, gae,
c, cae (chae),	*j*, jae,	*th*, thae,	*dh*, dhae (they),
s, sae	*z*, zae,	*sh*, shae,	*zh*, zhae,
r, rae,	*l*, lae,	*m*, mae,	*n*, nae,
h, hae,	*y*, yae,	*w*, wae,	*hw*, hwae (whay).

In this table but few innovations will be observed. *c* is made equal to *ch; dh* and *zh* are used for the sonant *th* and *sh;* and *h* is placed where it belongs, before the *w* in the combination *wh.* The letters *q* and *x* are not needed, but may still be used to avoid the awkward *kw* and *ks.*

In teaching this alphabet to children, and in spelling, the two characters which represent the long vowels and diphthongs should be pronounced as one sound, and not separately.

The following extract will give an idea of the appearance of the printed page in this system:—

Soundz at Ievning.

Swiet waaz dhe sound, hwen oft, at ievning'z kloez,
Up yondur hil dhe villaj murmur roez.
Dhair, az I past with kairles steps and slo,
Dhe mingling noets kaem sofnd from belo;
Dhe swaen responsiv az dhe milk-maed sung,
Dhe sobur hurd dhat loed tu miet dher yung,
Dhe noizi gies dhat gabbld o'r dhe puel,
Dhe plaeful cildren just let lues from skuel,
Dhe waac-dog'z vois dhat baed dhe hwispring weind,
And dhe loud laaf dhat spoek dhe vaekant meind;—
Dhies aul in swiet konfyuzhun saut dhe shaed,
And fild iec pauz dhe neitingael had maed.

OLIVER GOLDSMITH.

My object in this paper is not to present a finished system, but to show that the spelling reform is practicable, and to suggest a modification of the alphabet which will bring the desired relief. The time and energy wasted by a child in learning to spell would, if otherwise employed, be sufficient to give him an ordinary education. Let us do something at once to relieve education of this great burden.

The plan here proposed has the following additional advantages:—

1. The printed and written pages have no very unfamiliar look.
2. Print and script are easily read at sight by one who sees them for the first time.
3. One can learn in a few minutes to write in this system.
4. Its adoption will make no existing books obsolete or useless except a few primary school books.
5. It will give no special offence to the philologist.
6. It will lead easily to a better and more philosophical phonetic system.

ELECTRICAL NOTES.

The displays of high-voltage electricity which formed so prominent a feature of the late electrical exhibition held in the Crystal Palace, are not absent from the present one, but neither the display of Professor Elihu Thomson nor that of the Westinghouse Company approach, so far as spectacular effect is concerned, the exhibitions of Messrs. Siemens and Mr. Swinburne at the Crystal Palace. These latter were truly magnificent displays. They were, however, produced by high potentials obtained in the ordinary way, by transforming up, and on this account the experiments of Professor Elihu Thomson possess much more interest from a scientific point of view. The method used by the latter, as most electricians are aware, consists of passing a very rapidly alternating current through a few turns of a coarse copper wire wound round a glass tube placed in oil. Close to the coarse wire primary is wound a secondary of finer wire, and in this a very high voltage is induced by the current in the primary. This secondary current is also of very high periodicity, and all the Spottiswood and Moulton effects can be produced with it.

Owing, probably, to the resonant qualities of the room in which the Westinghouse exhibition takes place the noise of the discharge produces a very disagreeable effect on the nerves, even of those accustomed to working with high-potential discharges, so much so that one cannot help wondering at times if the powerful surgings in the ether do not directly excite the nerves as a battery does. It is true that in most of the high-frequency experiments no such effect is observed, but this may be because the quantity of current is in general very small. Meantime the coat-tails of the spectators can be seen, as Rudyard Kipling would put it, "crawling with invidious apprehension."

One of the signs of the times is the exhibit of electrical heating and cooking apparatus shown by the Ansonia Electric Company in the gallery of the Electrical Building. Here we see all manner of utensils, baking ovens, gridirons, chafing dishes, saucepans, coffee pots, etc., all arranged so that by simply attaching a plug to an ordinary lighting circuit they are put in operation at once. The subject is such an important one that the writer has thought it best to go into it more in detail (*vide infra*). Meanwhile it may be mentioned that the exhibit is well worth a visit.

The new Helios arc lamp, exhibited by the same firm, will also attract attention. This may be said to be, perhaps, the first thoroughly successful arc lamp for alternating currents. It is almost absolutely noiseless, and almost absolutely steady, more so than most direct-current lamps. These results are accomplished by the use of a low potential and of especially soft carbons.

It will be remembered that some years ago Mr. Edison brought out the kinetoscope. In this instrument a combination was made of the well-known zootrope and the phonograph, so that at the same time that the motions of the moving object were seen, the accompanying sounds were heard. The apparatus was exhibited at some of the charitable entertainments in New York through the influence of Mrs. Edison, but since then comparatively little has been seen of it. It has now been more fully developed and forms a part of the Edison exhibit in the gallery of the Electrical Building.

Among the instrument-makers the exhibit of Messrs. Queen & Co. stands preëminent. Their display is on the ground floor near the entrance, and includes almost every kind of electrical instrument made. A number of new instruments have been lately brought out by the firm. First among these we may mention Professor Ryan's electrometer, for use in making alternating-current curves. This instrument, which has already been described in the electrical papers and has been in use for some time at Cornell, consists of an electrometer whose needle is charged through a very fine platinum or silver wire to the potential of the alternating current machine, at any part of its revolution, by means of the ordinary commutating device. So far it does not differ very greatly from the ordinary electrometer. It is a zero instrument, however, and is brought back to its original position by the action of a current in a surrounding coil of wire, which acts on a small magnet fastened to the electrometer needle. The instrument being once standardized, the potential can be found by measuring the current passed through the surrounding coil, and this, from the nature of the operation, is a very short process. While the instrument has been known for some time, this is the first occasion, we believe, that it has been placed on the market.

It is to be hoped that some firm will do the same for the dynamometer method of Dr. Duncan, which has been used with so much success at Johns Hopkins.

Another very fine instrument is the cylindrical bridge. It is a very mechanical piece of work, and looks as if it could be depended on. With the Carhart commutator, standard ratio coils, and one of the new Ayrton-D'Arsonval galvanometers the electrician has a most complete apparatus for the measurement of resistances to almost any degree of accuracy.

These latter instruments (the Ayrton-D'Arsonval galvanometers), will probably interest the electrician more than anything else in the line of measuring apparatus. With electrical railways running in every direction near one's laboratory, the path of whose earth returns varies from day to day, with every sprinkle of rain or difference of temperature, the use of an ordinary sensitive galvanometer has been entirely out of the question unless in the neighborhood of a very strict law and order society, when a little work might be done by getting up to the laboratory at some unearthly hour on a Sunday morning. For this reason the tangent galvanometer has faded from the scene, and is now only used as a means of illustrating certain principles of electricity, its place being taken by Lord Kelvin's balances. And now the Thomson galvanometer must go before these new instruments, for the difference in sensibility is so small that there is practically no advantage in using the Thomson, even under the most favorable conditions, and under ordinary circumstances there is no comparison between them, the D'Arsonval type being absolutely unaffected by external magnetic disturbances. Moreover, a good Thomson costs at least $400, and an Ayrton-D'Arsonval only about $70.

Whether this form of galvanometer will be equally satisfactory when used for ballistic measurements does not, as yet, appear. There does not seem to be any reason why, with a good design and a containing tube of hard rubber instead of silver, it should not be perfectly satisfactory.

Several sets of improved portable testing instruments for measuring capacity and insulation of cables, etc., are worthy of attention. Full sets of the instruments of Lord Kelvin are also shown.

Another exhibit, which may well make an American feel proud of the work which is being done in this country, is the display of the Weston Instrument Company. True it is that Mr. Weston is an Englishman, but the perfection of the instruments is due, not only to Mr. Weston's ingenuity, but also, to a large extent, to American machine-shop practice. No other country can hope to compete with us until they learn to use the fine and accurate machine tools which fill the instrument shops here. The writer had the opportunity a short time ago of visiting some of the more celebrated European works for the making of electrical and physical instruments. There was not a universal grinder to be seen in them, and in only one was a modern milling machine to be found, and then but a single one. All the last touches were put on by hand, and the result may be seen in the instruments themselves, where every screw has to be marked, because no screw will fit accurately into any hole except the one it is made for, and no two parts of the same type of instrument are interchangeable. In Europe, all the fine work is done in the assembling, here the greater part is done before the instrument reaches the assembler's hands. Probably there is no instrument in the world whose mechanical make-up is so perfect as an ordinary Weston voltmeter. A number of new designs are shown, and the new laboratory standards are especially fine.

The long-looked-for manganin wire bridges have begun to appear, the smaller portable testing sets being now on exhibition. This manganin wire is, as the reader is probably aware, the invention of Mr. Weston, having been discovered by one of his assistants, Mr. John Kelly, while experimenting on that line. There are a number of varieties of this alloy, which is formed of different proportions of copper, nickel, and manganese. Some of these have a negative coefficient, others a slight positive one, and an intermediate class, no temperature coefficient at the ordinary temperatures of working. The researches of the German Government Standardizing Bureau have shown that the alloy is a permanent one, and that it is well adapted for use in standard resistances. It is understood that new bridges of the latest improved form, with four and five dials, are soon to be put on the market, made of this wire, and accurate to a small fraction of a per cent. Another new thing, soon to be put out, is the Weston cadmium standard cell. It is well known by those who have done work on solutions that the solubility of a number of the cadmium salts is the same at all temperatures within the ordinary range of working Also that there is a relation between the solubility and the voltage production of a solution. Mr Weston has utilized this property of the cadmium salts to form a cell (of a similar nature to the ordinary Clark cell, but with cadmium substituted for the zinc and zinc salts), whose temperature coefficient is practically nil. It is claimed that considerable usage has shown that it is very reliable.

As regards the electrical fountains, there is little to be said of them in spite of the great secrecy in which they are wrapped by the officials in charge. The principle is the one generally used, i.e., the projection of a beam of light so as to strike the walls of the jets from the inside, and so be reflected up along the inside of the column of water. Some slight mechanical ingenuity has been exercised in the means of feeding the carbons of the electric arcs, otherwise there is little of interest in the mechanism itself. The display, however, is very pretty, and it may be worth while to give a hint as to the best means of seeing it, as follows: —

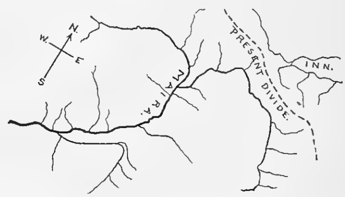
Take the electric launch at the wharf on the Liberal Arts side of the bridge connecting the Administration Building with the Liberal Arts Building, at about 8.30 or 8.15 in the evening (the exact time depending upon the time the electric fountains begin to play, the time of starting should be about 45 minutes before they begin). This will bring the launch back to the basin containing the fountains just about the time they are in full operation, and, as the boats make two turns round this lagoon, opportunity is afforded for a long view of the display. Moreover, the voyage around the other lagoons gives one a beautiful view of the grounds and buildings from the water. The illumination of buildings is well under way by that hour, and the long ride on the water is very enjoyable after the heat of the day. The writer has been informed by those who have had the opportunity of comparing the two, that even the most gorgeous sights of Venice do not enter into comparison with the view thus obtained. R. A. F.

A NEW INSTANCE OF STREAM CAPTURE.

BY HUNTER L. HARRIS, CAMBRIDGE, MASS.

The action of a rapidly flowing stream in cutting back into the drainage area of another, of less gradient, and, finally, capturing some of its headwaters, has been prettily described in the columns of this journal by Prof. W. M. Davis of Cambridge, under the name of "A River-Pirate." In this notice he describes an instance of such action occurring in eastern Pennsylvania, and alludes also to other instances, one of which is that occurring in the Upper Engadine of Switzerland.[1]

By keeping in mind the principles governing the cutting power of streams, we may easily picture to ourselves the conditions which would result from the excessive action of one stream over



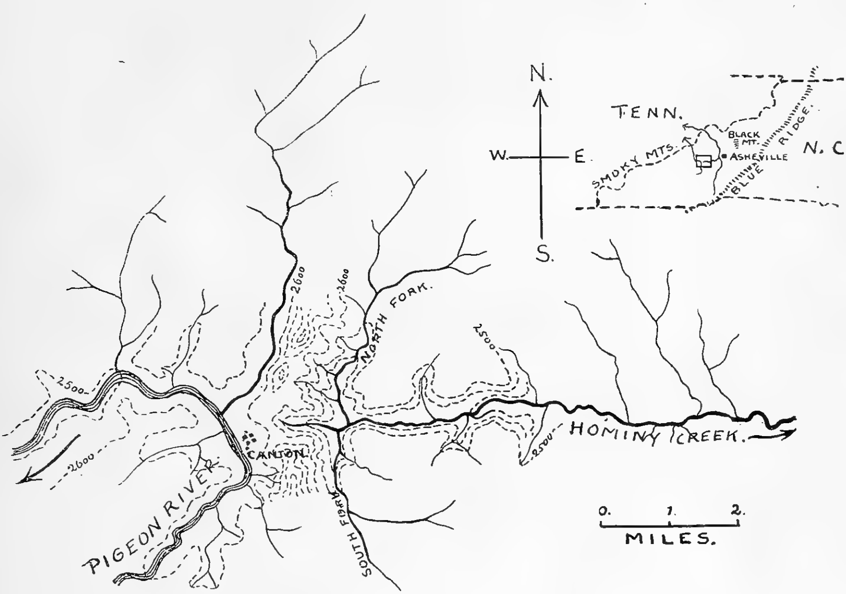
that of a near neighbor. Briefly, the more active stream, by virtue of its greater activity, would begin to enlarge its catchment basin, its headwaters eating their way gradually backward, and so pushing the divide farther and farther into the region formerly drained by the relatively weak stream. In process of time, the aggressive stream may actually tap some of its neighbor's headwater members, and, since the divide migrates unevenly, this tapping may occur either at the head, or at some point lower down on the invaded stream. If at the head, we may have a short inverted stream, which possesses few marks by which we may afterwards read its history. But if the connection takes place lower down, as is often the case, a peculiar back-set direction is given to the stolen tributaries which have been thus forced to discharge their waters through a new main stream of reverse direction. They may be compared to the barbs upon an arrow, the body of the arrow representing the pirate stream. This then constitutes a peculiarity by which we may easily recognize instances of such capture. But other evidence should be sought, such as the former comparative activity of the two principal streams, indications of the former course of the stolen tributaries, etc.

The case of the Upper Engadine mentioned above may be taken as typical. Here the aggressor is the Maira, flowing southwest, and it has not only taken a goodly part of the drainage area of the Inn, which has an opposite direction of flow, but has also appropriated at least three of its tributaries. The Maira is considerably more rapid, and hence more active, than the other. The accompanying sketch, taken directly from one of the maps of the Swiss official topographic survey, shows the characteristic form of the resultant drainage system.

[1] Vol. xiii., 1889, p. 108. See also R. de C. Ward, "Another River-Pirate," vol. xix., 1891, p. 7.

An instance of stream capture possessing all the "ear marks" of the typical case, is found in the Appalachian region of western North Carolina and within a few miles of Asheville. Among the principal streams traversing this elevated plateau region, are the Pigeon River and the French Broad, which take their rise on the broad back of the Blue Ridge, and, flowing westward, make their way through deep gorges in the Unaka Mountains, whence they descend into the broad, deep valley of eastern Tennessee. At one point, a northward turn of the Pigeon brings it within a dozen miles of the French Broad. Here, within half a mile of the former, and at an appreciably lower level, Hominy Creek takes it rise, and maintains a rapid, torrential course eastward, joining the French Broad at Asheville. A low and narrow divide separates this young and active stream from the slower moving Pigeon. Reckoning from this low divide, the fall of the smaller stream, within the first three miles, is more than three hundred feet, while an equal distance on Pigeon River yields a difference of level of only a little more than one hundred feet.

Here then are conditions favoring the lengthening of one stream with loss of territory by the other, and such has clearly taken place. The accompanying map is traced from the topographic map of the region made by the U. S. Geological Survey (Asheville sheet). It will be at once noticed that the branching headwater tributaries of Hominy Creek, instead of flowing with an easterly course like those which enter lower down, have a distinctly back-set position like the barbs of an arrow. A visit to the region would leave little room for doubt that these were once tributary to Pigeon River. The arrangement of the contours shows, in fact, a depression which may mark their former course over what now constitutes the divide.



INSECTIVOROUS PLANTS OF SOUTH FLORIDA.

BY G. W. WEBSTER, LAKE HELEN, FLA.

As one approaches the moist grounds bordering on the lakes and ponds so numerous in south Florida, a beautiful plant is often found that, while it attracts the attention of the ordinary observor, is especially interesting to the student of natural history.

Its 10 to 25 leaves of a reddish color and semi-transparent texture are all radical, forming a tuft or rosette generally not more than two or three inches in diameter, from the centre of which during the months of April and May it sends up a single flower stalk or scape 6 to 10 inches high, and bearing at its summit a one-sided raceme of light rose-colored flowers 4 to 5 twelfths of an inch in diameter. Its oval seeds, when seen through a microscope, are finely furrowed and covered with small granules arranged with perfect regularity.

The spatulate leaves are narrowed into a long leafstalk or petiole, the wide portion less than one-half inch in length and one-half as wide.

It is known to botanists as *Drosera capillaris*, and has the usual characteristics of the order Droseraceæ.

The leaves are circinate in the bud, that is, rolled up from the apex towards the base, after the manner of ferns. The upper surface is covered with somewhat fleshy, reddish filaments less than one millimetre in length in the centre of the leaf and gradually increasing to the length of 4 or 5 millimetres on the border. These filaments or tentacles are about 200 in number on each leaf, and each bears at its summit a gland which secretes a drop of perfectly transparent, viscid substance that glitters in the sunlight like a brilliant dewdrop, hence the common name of sundew.

This secretion is very adhesive, and whenever any small insect attracted by the brilliant color of the plant, the prospect of a sip of dew or from any other cause, alights upon the plant, it immediately becomes entangled in the treacherous substance. The tentacles of the outer border of the leaf, which were before curved backward, now slowly but surely begin to curve inward, carrying the victim toward the centre of the leaf, and enfolding it closely from every side. At the same time the secretion from the glands is greatly increased, drowning or smothering the insect. The leaf also slowly assumes a more cup-like shape and rolls back from the apex toward the centre of the plant and finally holds its victim in a close embrace, with the 200 glands pressed down upon it, bathing it in their secretion, which has now changed to acid and become capable of dissolving and digesting the soluble parts. These are taken into the circulation of the plant and by assimilation assist in its nourishment and growth.

When the work is completed, the leaf unfolds, the tentacles uncoil and again fold backward, leaving the skeleton of the insect in the centre of the leaf as a warning to all passing insects. A careful observation of the plants when in active growing condition will show all stages of the process. Some leaves will be folded up enclosing fresh insects, while many more will be seen spread open with the skeletons on their upper surface. Having finished their meal they are ready for the next customer. Occasionally the living insect will be found struggling to free itself from the adhesive secretion of the glands and the grasping tentacles that threaten its life. The larger insects often manage to free themselves and escape the fate that overtakes the less fortunate. I have seen the common house fly after being held for sometime finally extricate itself and fly away.

A great variety of insects, such as mosquitoes, small flies and bugs, become the victims of this carnivorous plant. Small spiders with their soft bodies seem to be especially adapted to supplying its demands.

The plant, which has but a few very small roots, can be easily transplanted to boxes where it can be more readily observed. A sufficient amount of the adhering soil should be taken up with it, which can be readily done by means of a common garden trowel.

In some experiments lately made I find that it generally takes from 24 to 48 hours for the leaf to become completely folded over an insect. Small house flies required in some instances 48 hours, and it was nearly two weeks before the leaf again unfolded. Small spiders, having softer bodies, were digested in less time. Small pieces of cooked beefsteak placed on the leaves at noon were enfolded by the next morning. At first the leaves appeared to be stimulated to extra activity, but the beef did not seem to be adapted to the sustenance of the plant. After a few days the leaves, instead of unfolding gradually wasted away, the tentacles withered and finally the whole leaf died, leaving the beef apparently but little changed. Pieces of wood or solid vegetable fibre placed on the leaves would be partly enfolded but only remain so for a day or two. Tender vegetable tissues in 48 hours were reduced to an apparently decomposed pulp.

Besides *Drosera capillaris* we have here in Volusia County two other species of Drosera; *D. brevifolia*, a smaller plant, not very common, grows in higher and dryer situations. The leaves are only about one-half inch in length, while the pretty flowers are quite conspicuous, being one-half inch in diameter.

D. longifolia is occasionally seen on swampy and overflowed lands, where it is found floating during high water, the few roots taking a feeble hold of the soil as the water recedes.

The Venus's fly-trap (*Dionœa muscipula*), also belonging to the order Droseracæa, I think has not been found so far south as Florida.

The spotted Trumpet Leaf (*Sarracenia variolaris*), also an insectivorous plant, is common here.

Bejaria racemosa, a shrub growing 2 or 5 feet high, with large and showy white flowers, secretes a viscid, sticky substance on the stems below the flowers, thus entrapping many insects. It is often called Fly Catcher.

It is the general law in vegetable physiology that plant life receives nourishment from two sources — First, from the more solid organic and mineral substances supplying phosphorus, potassium, sulphur, ammonia, etc., taken up by the rootlets and carried in solution to every part of the plant to be utilized in the process of growth, and, second, from the gaseous substances, oxygen, carbon dioxide, nitrogen and ammonia, drawn from the atmosphere through the stomata of the leaves. In carnivorous plants alone do we find the power of dissolving and appropriating organic substances through the leaves. In this power there is an approach made toward the function of the stomach in animals, thus forming another connecting link between the vegetable kingdom and those forms of life so nearly on the dividing line between the animal and the vegetable that it is sometimes difficult to determine on which side they really belong, and demonstrating to the student of biology that there is a unity in all life.

QUANTITY AND QUALITY OF MILK.

BY W. W. COOKE, STATE AGRICULTURAL EXPERIMENT STATION, BURLINGTON, VT.

SEVERAL attempts have been made to measure the effect of the period of lactation of the cow on the quantity and quality of the milk. In nearly, if not all, of these cases no account is taken of the food or the conditions. In this note it is intended to show how these changes during the period of lactation are modified by the abundance or scarcity of the food of the cow.

Most of the cows of Vermont calve in the spring, from February to May. We have the records of twenty such herds of about twenty cows each. Averaging these records, we get figures based on the doings of over four hundred cows. Hence the results ought to be quite reliable.

All results are calculated to thirty days in a month.

	April.	May.	June.	July.	August.	September.	October.	November.
Average daily yield of milk per herd, pounds.......	242	313	403	365	300	261	210	114
Ratio of different months, if June is 100..............	60	75	100	87	72	64	50	26
Average per cent of fat in milk....................	3.60	3.75	3.86	3.90	4.04	4.36	4.61	5.(7
Ratio of different months, if June is 100........	93	97	10)	101	104	112	119	131
Average daily yield of butter fat per herd, pounds	8 7	11.3	15 6	13.7	11.7	11 4	9.4	5.8
Ratio of different months, if June is 100.....	56	73	1(0	88	75	73	60	37

These cows were fed but little grain at the barn. They were turned to pasture in May and fed no grain while on pasture. As the pastures dried up in August and September, but little care was taken to keep up the flow of milk. Almost no grain was fed, and not much of fodder-corn or of fall mowings. When they came to the barn in November, no pains were taken, in most cases, to keep them along in milk. The feeding, then, may be said to be rather poor at the two ends of the season and an abundance of the best of feed in the middle.

Under these conditions there is a marked increase in the quantity of milk under better feed, reaching its height when the feed is best in June and skrinking still more markedly when cold weather and short feed occur in November. The changes in quality are especially worthy of note. There is a prevailing idea that when cows go out to grass the milk gets poorer in quality as it increases in volume. Some States recognize this belief in their statutes by lowering the legal milk standard during May and June. Many tests at this station during four consecutive seasons have shown the incorrectness of this belief, and the figures of these 400 cows show the same very conclusively.

The per cent of fat is lowest just after they calve, and there is a rapid increase when they go to pasture, and a continued increase each month until at the last the increase is very rapid.

It is to be noted, however, that this increase of fat per cent is not enough to counterbalance the decrease in the weight of the milk, so that the total daily fat decreases during the fall months in spite of the increased rickness of the milk.

If these records are compared with those of the station herd that have been full fed all the year, it will be seen that there are no such violent changes. When the cows go to pasture the milk increases quite a little, but the fat remains about the same, and for the first eight months of lactation there is only a slight change in per cent fat, and no very large decrease, and no sudden decrease in quantity of milk. Also, it will be noted that in our herd there is not so large an increase in per cent fat at the end of the period of lactation. But few cows change one per cent from richest milk of last month before drying up to thinnest milk after calving.

The following is the record of six cows at the Experiment Station Farm that calved in the spring and were fed at the barn heavily with grain, hay, and ensilage, before and during pasturage, and also after their return to the barn until they dried up.

	April.	May.	June.	July.	August.	September.	October.	November.
Average monthly yield per cow, pounds............	792	867	948	814	723	711	531	340
Ratio of different months, if June is 100...............	84	91	1 0	86	76	75	56	36
Average per cent of fat in milk.....................	4.07	4.38	4.38	4.28	4.37	4.52	4.70	4.83
Ratio of different months, if June is 100...............	93	1 0	100	98	100	103	107	110
Average monthly yield of butter-fat per cow, lbs...	32.2	38 0	41.5	35.8	31.6	32.1	25.0	16.4
Ratio of different months, if June is 100..............	78	91	100	84	76	77	60	40

The influence of full feeding is seen most strongly during the months of April and May, which yield, with grain, one-third more milk and butter-fat than without. An influence after June is seen, but not so pronounced. Those having grain shrink in milk-flow only nine-tenths as fast as those not having grain, and have the advantage of only one-twenty-fifth in the shrinkage of butter-fat.

Of course, this is not a strict comparison of the effects of feeding grain on the total yield or of the financial side of the question, but merely of the effect the grain has of increasing the flow of the milk at once when the cow calves and of maintaining the milk-flow for a longer period in the latter part of lactation.

LETTERS TO THE EDITOR.

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

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

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

An Unusual Aurora.

ON Saturday evening, July 15, there occurred an aurora which was unlike any the writer has ever seen, and a brief description of it may contribute something to the aggregate knowledge of those interesting phenomena.

The peculiar feature of this aurora was the movement of a series or succession of whitish flecks across the sky from east to west, resembling somewhat the waves of a body of water.

About 9.30, central time, my attention was first attracted to it. Flecks of white light were forming in the east at an altitude of about 45°, passing in regular succession westward, about 20° north of the zenith, and apparently accumulating in one larger band in the northwest, reaching at times from near the horizon to perhaps 80°. The white flecks or streaks were about 10° in length, strictly parallel north and south, and quite uniform in distance apart. They grew brighter and more distinct as they approached and passed the meridian. Their motion was very regular and quite rapid,—comparable to the swiftest apparent motion of light clouds. If they were as high as the electric theory would suggest, the velocity must have been enormous.

At times similar short bands, like strokes with a paint-brush, were stationary in the north, at about 45° altitude, for several minutes at a time.

A few minutes later a number, perhaps ten or twelve, white bands appeared north of the zenith, all converging towards a point some 10° south of the zenith, but vanishing before reaching the zenith. They remained only a few minutes. About 10 o'clock the moving flecks had disappeared, and one long, straight band extended from the northwest horizon, 50° or 60°, toward a point about 45° south of the zenith. Two or three other short flecks appeared parallel with the main band. About the same time the usual diffused glow appeared in the north horizon and continued till after 11 o'clock, but was not observable while the moving bands were seen. Many more gorgeous auroras have been seen in our latitude, but the rapidly-moving bands gave this one a new interest.

W. H. HOWARD.

Adrian, Mich.

Light-Shunners and Light-Seekers.

It is well known that in the main divisions of the animal world we find groups which normally withdraw from daylight and which form a very large minority of existing species. Some of these lovers of darkness dwell in caverns, in underground burrows or in the seas at depths where the light penetrates feebly or not at all.

We might, perhaps, expect that such creatures would feel annoyed, more or less, by artificial light and would withdraw from what to them must be an exceptional phenomenon. This, however, would be a mistake. The only nocturnal animals which seem to shun fire and light are the carnivorous mammals especially the cats. It has long been customary for travellers in Africa to keep lions, leopards, etc., aloof from an encampment by means of bonfires. As a rule the sleepers are safe as long as the fires are fed up.

The lemurs and loris are even more nocturnal than the cats, since they do not travel or prey by day. Whether they are repelled or attracted by a light is not sufficiently decided.

The bats are not purely nocturnal. They are sometimes seen hawking for insects in full daylight. But a light attracts them. Entomologists — I may mention Major Elwes, F. E. S. — who have hung out lamps in order to entice moths, have often found that bats come to the lights and secure a large share of the specimens.

Among birds there are few truly nocturnal species. The owl and the night-jar (absurdly called the goat-sucker) are the most common night fliers. The owls are attracted by a light, a fact which has given rise to a foolish superstition. They will often dash against the window of a room which is lighted up by night. If, as often happens to be the case, this is a sick-chamber, nurses of the old school pronounce such a visit a fatal omen. Some would-be wise men have gravely asserted that the owl scents the approach of dissolution and comes in the hope of feasting upon the corpse. Now, in fact, the owl feeds by preference on prey which it has just killed, and in captivity it rejects any food which is in the slightest degree tainted.

In Australia the emu, though not truly nocturnal, may be seen rapidly scudding over the plains by moonlight.

Many birds which are perfectly diurnal, in their ordinary habits, fly by night when migrating, and are then attracted by a light. Numbers of various species dash themselves against the windows of lighthouses and are killed by the shock. This is much to be regretted, since the majority of migratory birds feed on insects, and had they survived they would during the coming season have been hard at work ridding our crops of vermin.

The habits of reptiles vary greatly. The few European snakes, e.g., the viper, the asp, the Austrian adder, the grass snake and *Coronella lævis*, are rarely met with save in the brightest hours of the day. But of the African, Indian and Australian species it may be said:

"The snake that loves the twilight has come out, beautiful, still and deadly"—though they also bask in the sun. Nor are they scared away by lights or fire. One species, indeed, if it espies a fire in the forest, seeks to dash or drag the sticks away. Toads, newts and salamanders live very contentedly in the dark, but seem to regard a light with indifference.

The majority of fishes and other dwellers in the waters are decidedly attracted by lights.

It is well known in various countries that fishes swim up to a boat on a stream if a light is displayed on board.

An interesting spectacle is produced if a candle, or better still an electric glow lamp is brought near the glass sides of an aquarium. Fishes, aquatic larvæ and mullusca swim up and seek to come as near as possible to the light.

Numbers of nocturnal insects are attracted by flame. Moths, gnats, crane-flies and many other diptera are noted for their propensity to commit suicide in our lamps and candles. Many of the smaller moths are found sitting on the glasses or the iron frame work of street-lamps. I have known an old lady made ill with fright because a death's-head (*Acherontia atropos*) had flown against her candle and put it out.

But we must now glance at the main question, that is, the meaning of the behavior of nocturnal animals in presence of a light. The alarm of many species is not hard to understand. A bright light is a phenomenon which does not fall within the limits of their experience and seems to them, therefore something to be avoided. But to see nocturnal, abysmal or cave-dwelling species flocking to a light is perplexing.

It has been suggested that the moth thinks the flame an outlet through which it may escape. But why should it seek to escape from a condition which to it is as normal as is sunlight to the butterfly or to the bee? It has again been suggested that nocturnal insects and fishes are able to preceive the faint phosphorescent light apparently given off by many flowers, and by aquatic worms, etc. Hence the moth rushes to the lamp mistaking it for a flower. On coming nearer he is bewildered by the intensity of the light and "loses his head." This same supposition explains why mosquitoes are less attracted by a lamp than are most other insects. They are not accustomed to find their food in phosphorescent flowers, hence the lamp has to them little attraction.

True, this hypothesis fails to show why birds should dash themselves against the windows of a lighthouse. Their normal food is not phosphorescent. Nor, to our knowledge, are their eyes capable of perceiving a faint phosphorescent light.

Probably no single hypothesis will meet all the cases of the attraction of animals to light. J. W. SLATER.

London, England.

The Aurora.

The contradiction in certain statements of mine with reference to the possibility of tracing the relation of the aurora to disturbances upon a particular part of the sun in certain years which Professor Ashe thinks he has detected and which he puts into italics at page 9 of *Science* for July 7 amounts to simply this: In one sentence which he quotes I am giving the reason why the relation in question comes out distinctly in years of minimum, namely, because the disturbances are well separated from each other, and, taking 1879 as an example, show by a table that this was the case in that year, in which both auroras and sunspots were so very few that the numbers to be employed were so extremely small that it might justly be doubted whether they show anything, and yet, in spite of this disadvantage, namely, the smallness of the numbers, the relation was plainly apparent. In another sentence, referring to the matter from this point of view, namely, the size of the numbers to be employed, I state that in 1880 the relation in this respect would be much more distinct, this also being a year of comparative minimum in which the disturbances were well separated from each other, so that the conclusion with reference to this year contained in the sentence which Professor Asche quotes would be fully justified, i.e., "the numbers would be larger and the relation in every way more distinct." The only reason for the publication of the table for 1879 was to show what would appear in the year in which we might suppose the relation exceptionally difficult to trace and yet in which it was distinctly apparent in spite of the smallness of the numbers. It was simply picking out the worst possible case, as we would naturally suppose, instead of the best possible case, and it is to its discussion that the sentences which Professor Ashe quotes, refer. M. A. VEEDER.

Lyons, N. Y., July 13.

Natural Selection at Fault.

I AM truly sorry if, in my remarks on this subject, I have failed to make myself understood. As regards the common cat, I have seen not merely half-grown kittens, but middle-aged mousers, play with their booty and lose it.

The idea of this practice having the object of cultivating agility seems to me exceedingly far-fetched.

I have not sought to account for the cackle of hens, but have merely pointed out the undeniable fact that it is very liable to attract the attention of any ovivorous bird or beast to the probable presence of an egg.

The rarity in man of the power to erect the ear, or to turn it so as to catch any faint sound-waves has been repeatedly noticed, as also the fact that it does not collect all the impinging sound-waves into the orifice of the ear. My only merit, or demerit (?), has been to cite the abated condition of the ear-muscles as an instance of natural selection at fault. The ear is probably in a state of transition, but in what direction? J. W. SLATER.

London, England, April, 25.

The Habitat and the Diet of the Lepidoptera.

A FEW lepidopterous species select in different countries widely different habitats and food plants. Thus *Papilio machaon*, the most common European species of papilio, is confined in England to the fenny districts of Cambridgeshire, and occasionally extends to small portions of the adjoining counties. What with the greediness of collectors for "British specimens" of any remarkable insects, and with the drainage of the fields, it is feared that this species will soon be extirpated. The caterpillar of this species, in England, feeds on swamp plants.

In central Europe *Papilio machaon* is fairly abundant on the dry, gravelly hills and certain parts of lower Silesia, Bohemia and Saxony, the very opposite in their character to the fields of Cambridgeshire. The larva in Silesia and Bohemia feeds frequently on the mountain ash.

The three hawk moths, *Chanocampa celerio, Ch. elpenar* and *Ch. porcellus*, on the European continent, feed chiefly upon the vine. But in England they feed on bed straw, willow herb and sometimes on the fuchsia. I have in vain tried to induce larvæ of elpenar or porcellus to feed on vine leaves, probably if the ova had been placed upon vine leaves the young larvæ would have not refused this, their normal food. J. W. SLATER.

London.

Beaver Creek Meteorite.

Between the hours of 3 and 4 P. M. on the 26th of May last, a meteorite was heard by many persons, and three of the fragments were seen to fall near Beaver Creek, West Kootenai District, B. C., a few miles north of the United States boundary.

The two smaller of these fragments, weighing perhaps 5 to 6 pounds in all, were picked up at once; the larger one, weighing about 25 pounds, was not found until the next morning. It made a hole in the wet earth about three feet deep, two feet in soil and one foot in hard pan. The direction of the hole was south 60° east, true meridian, and at an angle of 58° with the horizon.

Fresh earth was scattered about the hole in all directions, but farthest (10 feet) in the direction from which the stone came.

On the 6th inst. I saw and purchased this stone from Mr. James Hislop, a civil engineer, who found it and brought it to Washington.

It is a typical aërolite of very pronounced chondritic structure. It is completely coated with the usual black crust, except at one end, where about three pounds have been broken off and scattered, like the two smaller stones, mostly among mere curiosity hunters. The mass now weighs 22½ pounds, measures 6 × 7½ × 9½ inches, and approaches in shape an acute octahedron.

I propose for it the name of *Beaver Creek*, from the stream by the banks of which it fell.

A microscopical examination and chemical analysis will be made soon. EDWIN E. HOWELL.

Washington, D.C.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange.—A complete set of the report of the last Geological Survey of Wisconsin, T. C. Chamberlin, geologist. It consists of four large volumes, finely illustrated, and upwards of forty large maps and charts. Will sell for cash or exchange for a microscope. Address Geo. Beck, Platteville, Wis.

For sale or exchange for copper coins or rare postage stamps. Tryon's American Marine Conchology, containing hand colored figures of all the shells of the Atlantic coast of the United States. Presentation copy, autograph, etc. One vol., half morocco, 8vo, usual price, $25, postpaid, $15. Botany of the Fortieth Parallel of the Hundredth Meridian of the Pacific R. R. Survey. Other Botanical works and works on Ethnology. F. A. Hassler, M.D., Santa Ana, Cal.

I have a fire-proof safe, weight 1,150 pounds, which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

For exchange.—Hudson River fossils in good condition from the vicinity of Moore's Hill, Ind., also land and fresh water shells. Desire fossils and shells from other groups and localities. Address Geo. C. Hubbard, Moore's Hill, Ind.

For sale at low price.—A fine old-fashioned photographic camera, rosewood box, one foot square, lenses, four inches diameter, made by C. C. Harrison. Plateholders, troughs, baths, etc., all in large wooden case, formerly the property of the late President Moore, of Columbia College. This is a fine example of an instrument of the best make for the old wet-process methods, and valuable to any institution or amateur interested in the history of photography in the U. S. Address M. S. Daniel, 236 W. 4th St., New York.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

For exchange.—I wish to exchange Lepidoptera of South Dakota and other sections, for Lepidoptera of the world. Will purchase species of North America. Correspondence solicited, particularly with collectors in the Rocky Mountains, Pacific coast and Hudson's Bay regions. P. C. Truman, Volga, Brooking county, South Dakota.

Wants.

A YOUNG man who has been through the course in mathematics in Princeton University, wishes some tutoring this summer. Rates reasonable. Address P. H Westcott, Cramer's Hill, Camden Co., N. J.

A GRADUATE of an American Polytechnic institution and of a German university (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry, Address Chemist, 757 Cary St., Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

A ZOOLOGICAL collector and taxidermist of ten years' experience in the field is now open to engagement, for either field or laboratory work. References furnished. Address Taxidermist, Box 75, White Sulphur Springs, West Va.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi, cyrtonyx montezumae, deudragapus franklini, lagopus welchi, tympanuchus cupido* and *pedioecetes phasianellus.* Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3922 Fifth Avenue, Pittsburgh, Pa

QUERY.

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

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N. D. C. HODGES, 874 BROADWAY, N. Y.

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SCIENCE

NEW YORK, JULY 28, 1893.

SYSTEMATIZED GRADUATE INSTRUCTION IN PSYCHOLOGY.

BY E. W. SCRIPTURE, NEW HAVEN, CONN.

Instruction in psychology cannot be said to have been placed on a sound basis till it consists of a series of carefully graded teaching from elementary text-book instruction to the highest kind of original work. Haphazard work here is just as bad as anywhere. It is self-evident that the student of psychology should properly apportion the amount of time spent in its various departments and in the other sciences he will have need of. The man who starts with the supposition that the way to study psychology is to go into the anatomical laboratory on the one hand and to take heavy courses in Greek philosophy on the other, is losing much valuable time. It is hereby not implied that no time is to be given to these subjects any more than that geometry and history are to be omitted from a man's education. But when a man has finished his college work and goes to the university he is supposed to have received his general culture and to be ready for his life-work.

The specialist is a man of broader knowledge than the dilettante. The difference between the two is that the latter browses at random, while the former reaches over a much wider field, but with a careful selection and coördination of the portions related to some central point. There is a maximum of energy and health which a man can employ in work; if this capital is invested in a careless way it will bring in small returns; the man will never really gain a complete training in anything.

The problem of a specialist is to go over as much ground as possible; to do this it is necessary to pass rapidly over the less valuable portions in order to have time for the valuable ones further on. Moreover, no essentials should be overlooked, no matter how distant they apparently lie. This last requirement is probably the most important of all. There is many a psychologist to-day who is fatally weak in some one or more points; it would be easy to find those who, although making measurements, know nothing of the science of measurement, or who, using light, heat, etc., as tools in their experiments, have little idea of the laws of the forces they are handling. To remedy all these defects in the dilettante way a man would have to study a couple dozen sciences; since life is too short to learn even one with any respectable thoroughness, the only way to do is to take just what will be of the most advantage to the psychologist, always bearing in mind that an hour too much on any one point means an hour too little on some other one.

It is the first problem of the psychological laboratory or the psychological department to so arrange its courses as to satisfy these requirements. As my own experience may possibly be of use to some one I will indicate briefly the outline of a system of instruction designed to meet this want. It is to be borne in mind that I am not speaking of college work with the object of general culture, but of serious university work for one who desires to study psychology.

As the science of psychology to-day is based on measurement and experiment, the work of the student must begin with some considerations on the method of making experiments; this should be followed by careful work in the theory of measurements, treating of the probability integral, the mean variation, etc. This work resembles somewhat the corresponding work given in physical measurements, but although the mathematical principles are the same, the treatment differs considerably. One of the great differences between psychological and physical measurements is that the conditions cannot yet be as accurately controlled as in physics; our mean variations are thus greater and the deductions we can draw from the results are not the same. In this respect psychological measurements on a single person somewhat resemble measurements taken once on each of a large number of persons. Partly for this reason, but mainly also for the sake of mental statistics, a study of the methods of statistics has to be made. The making of measurements brings in the study of fundamental and derived units and the construction of apparatus. The study of the various subjects of touch, sight, hearing, etc., requires a consideration of the physical processes used in stimulation. Thereafter the usual psychological subjects are, in a lecture course, to be treated in detail.

Hearing lectures will never make a psychologist; the fundamental course for all special instruction is the laboratory work. The student must be trained by repeated exercises in making the measurements explained in the lectures, including exercises on touch, temperature, hearing, sight, in the graphic method, chronometry, dynamometry, audiometry, photoptometry, colorimetry (psychological), etc. This should be followed by work in the construction of apparatus, elements of mechanical drawing, use of tools, etc. It is of great importance not to have too many men at work at the same time, at least not until psychological laboratories are much enlarged. During the past year the average attendance on this course in the Yale laboratory has been eight, an unpracticable number. Even with the enlarged equipment for the coming academic year, the number admitted to this practice course will have to be limited.

The object of university instruction, as distinguished from college training, is to develop the love of research, to train the student in research methods, to furnish him with the requisite knowledge and skill, and finally to provide him with the apparatus and other means of work for carrying out such investigations as may be best for him to undertake. The requisite knowledge of the psychological methods is gained from the laboratory course, the training in the difficulties and methods involved in research is obtained by placing the newer students as helpers to the advanced ones. The importance of this last arrangement can hardly be overestimated. It is the one in vogue at Leipzig and elsewhere.

It is a very dangerous thing for a man to take up a problem for investigation unless by previous experience with some one else he has found out that research is the hardest kind of work and has learned the thinking, the untiring patience, the courage under defeat that are called for at the various stages of work.

If we regard the research work as a means of training, it is an important matter to the student that he shall not undertake problems with rather indefinite boundaries or those where he may perchance run wild or be led into careless work. There can be no better training than that found in the investigation of a single point where the most careful measurements and manipulation are required. Once the student has learned the proper habits he will do far better work with suggestive and uncertain problems than could otherwise be hoped for.

If a student has had the proper general culture in philosophy, physics and mathematics, such a course as that outlined ought to make a thorough psychologist out of him. If he has not had the proper college training it behooves him to make it up as fast as possible. In the first place, an acquaintance with German is absolutely indispensable. Some acquaintance with the epistemological theories of the day is also necessary. A thorough scientist in psychology could not get along without knowing something about calculus, at least enough to follow the developments in such works as Müller's *Grundlegung* or Weinstein's *Physikalische Maassbestimmungen*. The more physics he knows the better.

OUR CRIPPLED WEATHER SERVICE.

BY JAMES P. HALL, BROOKLYN, N.Y.

A recent order of the new Secretary of Agriculture stops all the scientific research which, until this month, was being conducted by the United States Weather Bureau, and limits the functions of the experts in the Central Office to mere forecasting. Quite apart from all personal and political considerations, this is a lamentable event on many accounts.

It appears to be necessary, even in this enlightened age, to prove afresh that "pure science" is a prerequisite to most of our material progress. We are still under the necessity of making out that Columbus, who conceived that other lands lay to the westward of the great Atlantic, who visited one potentate after another to secure aid for his schemes, who haunted the courts and camps of Ferdinand and Isabella year after year, and who backed up his case with only the calculations of "pure science," really served Spain in particular, and civilization in general, quite as well as the "practical" men who handled the ropes and sails of the three caravels. We must elaborately demonstrate, all over again, to some of our fellow-countrymen that the unknown inventor of the mariner's compass and those other "pure scientists" who make charts showing the deviation of the needle, have conferred as great benefits on mankind as the pilot who uses that quivering bit of steel in bringing his ship safely across the seas. We must be prepared to face a question whether the captain of a New England fishing smack who thumbs his almanac to find out at what hour the tide rises or falls on a given day is not, after all, the superior (as an agent in civilization) to those learned astronomers and mathematicians who compute the tables for that little pamphlet. We must not be surprised if sane, intelligent, even eminent men, tell us that all the amazing development in steel production which we have witnessed in Europe and America in the last quarter of a century would have come just as soon—perhaps sooner—if Henry Bessemer had not carefully evolved his wonderful process from chemical theories and laboratory tests, nor ought it to startle us if some one insists that the sweating laborer in a rail mill, who grasps with tongs the fiery snake which emerges from the rollers and drags it away to have its ends sawed off, does more toward the building of a safe and lasting road than the expert who sits at a table and figures out the precise cross-section of rail that will give the greatest resistance to all the complex strains to which those bars must be subjected in service, even though these calculations extend over years and are based on long-extended and carefully designed tests. We cannot count on the universal acceptance of our opinion—if it happens to be our opinion—that Roebling, in computing the exact size and number of the wires to hold up a bridge over East River, and in drafting all the plans for that wonderful structure, was at all comparable in usefulness with the truckman who now drives a two-horse team across it every day. If we positively assert that the projectors of the great railway systems beyond the Mississippi have done more than the men who drove spikes with sledge-hammers to open up that region to settlement and to provide outlets for the enormous grain and pork product which has resulted, we know not how soon nor how flatly we shall be contradicted. We may meekly hint that the physician who prescribes does as much to cure us as the drug clerk who compounds the prescription; that the arithmetic maker is as much of a public benefactor as the corner groceryman who foots up the total cost of ten pounds of sugar and two pounds of coffee; that Edison, who perfected the incandescent lamp after long years of experiment with no end of substances for his filament, did as much to give us an electric light as the man who tacks up cloth-covered wire in our offices and screws pear-shaped globes into wall-fixtures; that Graham Bell was quite as instrumental in enabling us to converse over a wire with people a dozen miles away as the patient girl who answers our ring and sticks a little brass plug in a hole for us; and that we owe as much to the long array of designers, from Watts to Buchanan, who have brought the locomotive engine up to its present perfection, as the engineer on the "limited" express for the marvellous speed we make in going to Chicago; but we must not mistake for conviction the tolerance with which these utterances are received.

And so in meteorology. There are minds so constituted that they regard the observer as the equal or superior of the inventor of the barometer and thermometer; the "practical" man who jots down figures on a map and then draws "isobars," "isotherms" and wind signs on it as more useful than the pure scientist who, without touching pencil to paper, studies the movements of high and low pressure areas across the country, and the man who guesses what changes will occur during the next twenty-four hours, in the shape, size, position, intensity and other features of the cyclonic and anti-cyclonic systems, are doing better work than one who discovers and formulates the laws that govern those changes, and thus renders forecasting possible. What makes this the more amazing is the insufficiency of our present rules for weather predictions. The principles involved are not yet fully established. The most successful experts in this line realize that they are working under only a provisional code that must be greatly modified and supplemented. There is not a science so young and undeveloped as meteorology; there is not a bureau in the national government whose maxims and procedure are not better established, nor, when one considers the immense and varied interests—railway, shipping, agricultural, commercial and individual—which are affected by the weather, is there any branch of the service which affects so many people, and affects them so directly, as this, unless we except the postal business? Not to strain every nerve to improve the quality and character of the work by fuller inquiry into fundamental theories is folly, if not crime. Such a policy of neglect involves direct waste, as ignorance always does. Our expenditure, year after year, would not thus be made to the best possible advantage. On the other hand, to use one per cent ($10,000), out of the $1,000,000 appropriated for the bureau, in expert work, would be a measure of true economy by gradually revealing how best to use the rest. That has been true of the bureau from the start; and it has never been a wiser course than it would be now. Any manager of a creamery, sawmill, cotton factory, iron foundry or railroad who deliberately threw away such a chance as this for improving what everyone recognized as the inadequate facilities of his business, at a trifling cost, would be set down by "practical" men as strangely blind or culpably reckless.

ANALOGOUS VARIATIONS IN SPHAGNACEÆ (PEAT-MOSSES).

BY H. N. DIXON, F.L.S., NORTHAMPTON, ENGLAND.

IN the "Origin of Species" (6th ed, p. 126) there is the following passage, under the heading of "Analogous Variations:" "As all the species of the same genus are supposed to be descended from a common progenitor, it ought to be expected that they would occasionally vary in an analogous manner, so that the varieties of two or more species would resemble each other, or that a variety of one species would resemble in certain characters another and distinct species,—this other species being, according to our view, only a well-marked and permanent variety."

A clear example of this is of considerable value in the support it gives to the theory of descent; but, as Darwin goes on to show, there are several reasons why such examples are not common.

A very striking illustration is, however, to be seen among the peat-mosses, or species of Sphagnum, and, as I do not know that anyone has drawn attention to the facts from this point of view, I think it may be of interest to present them briefly. Many of the facts quoted below are taken from a paper by C. Jensen (translated in the *Revue Bryologigue*, 1887, p. 33, by F. Gravet), entitled "Les Variations Analogues dans les Sphagnaceés."

Sphagnum acutifolium may be taken as a typical species of the genus; in its most characteristic form it is a plant with tall, slender stems, bearing at intervals fascicles of simple branches of two kinds, the one (divergent) stouter and more or less horizontal, the other (pendent) longer, thinner, straight, and appressed closely downwards to the stem; the leaves on the branches being closely imbricated all round. The stem bears leaves very different in form and structure from those of the branches.

Now *Sphagnum acutifolium* is a most variable moss; the list of recognized species in Europe alone numbering about thirty.

Among these are several distinct and well-marked forms, such as the following: In one the branch leaves, instead of being straight and closely imbricated as described above, are bent back in the middle and spread almost at right-angles from the branch — the *forma squarrosa*. In a second the branches, instead of being straight or nearly so, are hooked or contorted — the *falcate* variety. In a third, the *forma compacta*, the whole plant takes a short, compact habit, the stems being much shortened and closely tufted, the fascicles of branches close together, and the branches themselves short and stunted, with the leaves closely set. In a fourth the differentiation between the stem and branch leaves almost or quite disappears, the former acquiring the form and structure of the latter, the *forma homophylla*, and so on with two or three more distinct varieties.

Now, if we turn to the other species of the genus, we find that of those found in Europe and North America there is hardly one which does not include one or more of these six or seven distinct varieties which we find in *S. acutifolium*. Thus of nineteen European species (all but two of which are natives of North America) sixteen, and perhaps eighteen, have varieties belonging to the *forma compacta*, fourteen at least, and perhaps four others, have the squarrose variety, and so on to a greater or less degree with the other forms. At least two of these forms are found under every one of the species, and in more than one species all the forms are found.

Here we have a clear case of analogous variations. It cannot be supposed that they are instances of reversion to a common ancestral form, for, apart from other considerations, the variation in some of the forms is in a directly opposite direction to that which it takes in others. The delicate, elongated forms of the *tenellæ* and the dense, compact forms of the *compactæ* can hardly both be reversions to a common ancestral type!

So far we have exactly the same thing that we see in many races of domesticated species, such as Darwin has pointed out, for instance, in the races of the domestic pigeon; but we do not often see it carried out on such a wide and instructive scale.

But what is of especial interest in the case of the Sphagnaceæ is that, when we go further and consider the characters that distinguish the different species from one another, we find that the very points which we have seen mark off the above varieties (and render them, as a rule, more distinct than the other varieties of the species) are in several cases those which are most characteristic in separating from one another the species themselves. Thus *S. squarrosum* is specially marked by the spreading leaves; *S. rigidum* has for its most obvious features the very characteristics by which the *compacta* forms above described are distinguished; *S. subsecundum* in most of its forms is marked by its falcate or contorted branches; while a group of species, classed by Lindberg as HOMOPHYLLA, are characterized by that similarity of stem and branch leaves which I have described above as the feature of the corresponding variety; and so on with the other forms. Here we have exactly fulfilled the supposition of Darwin quoted above, "that a variety of one species would resemble in certain characters another and a distinct species," and fulfilled, too, on a scale which, at any rate, precludes the possibility of its being due to fortuitous coincidence.

On any theory of creation that did not presuppose a common ancestry for these species of Sphagnum, it might indeed be possible to account for the analogy between the varieties of different species by assuming the variations to be the direct results of the environment (a more than doubtful assumption, moreover); but the more we lay this cause under contribution to account for the varietal forms, the harder it is to believe that precisely the same variations in the species, only carried out to a higher degree of permanency, are due to entirely different and quite unconnected causes.

The above facts appear to me to form a peculiarly interesting support to Darwin's argument from analogous variation. In the first place, the possibility of reversion is, as I have pointed out, eliminated, and reversion and analogous variation, which are quite distinct principles, are too often indistinguishable in their results for us to be quite certain that we have a genuine example of the latter. In the next place, as Darwin points out, analogous variations are liable to be eliminated as not being necessarily serviceable; that they are not eliminated in the Sphagna is, I believe, partly due to the peculiar conditions under which these plants usually grow, but this opens too wide a field to enter upon here. In addition to these reasons, we have here an illustration drawn from species and varieties in a state of nature; examples of analogous variations have usually to be drawn from domesticated forms, where their value is limited by their necessarily applying to races and varieties only, and not to distinct species.

I append a table (taken from Jensen's paper quoted above), which shows at a glance the distribution of these varietal forms among the European species of Sphagnum. A † indicates the existence of the variety heading the column under the species opposite to which it is placed; a ? means that the existence of such a form is probable, but is insufficiently attested or not clearly enough marked to be entered as certain. It must be remembered that there is always a possibility of gaps being filled up by future research, but the table is, I think, as it stands, sufficiently striking.

Group.	Species.	Forma homophylla.	Forma compacta.	Forma tenella.	Forma falcata.	Forma squarrosula.	Forma immersa.
Sphagna cuspidata.	Sphagnum laxifolium, C. M.		?		†	?	†
	" intermedium, Hoffm.		†	†		?	†
	" riparium, Angstr.					†	†
	" lindbergii, Schimp.		?			†	†
	" wulfii, Girg.		†			†	?
	" acutifolium, Ehrb.	†	†	†	†	†	†
	" strictum, Lindb.		†			†	?
	" fimbriatum, Wils.		†			†	?
	" teres, Angstr.		†			†	?
	" squarrosum, Pers.		†			†	†
S. subsecunda.	" subsecundum, Nees	†	†	†	†	†	†
	" caricinum, Spruce	†	†	†	†	?	†
	" tenellum, Ehrb.	†	†		†		†
S. compacta.	" compactum, D. C.		†			†	†
	" molle, Sull.		†			†	
	" angströmii, C. Hartm.		†			?	?
S. palustris.	" cymbifolium, Ehrb.	†	†			†	†
	" papillosum, Lindb.		†			†	
	" austini, Sull.		†			†	?

THE CLOSE OF THE ICE AGE IN NORTH AMERICA.

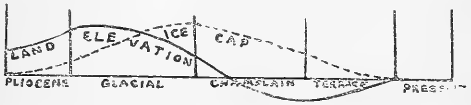
BY R. W. MCFARLAND, LL.D., LATE PRESIDENT OF MIAMI UNIVERSITY.

THIS is a question of interest to scientific men in general, and to geologists and glacialists in particular.

In Professor Wright's "Ice Age in North America," p. 448, in speaking of Croll's table of the eccentricity of the earth's orbit, he says: "According to this table the modern period most favorable to the production of a glacial epoch began about 240,000 years ago, and ended 70,000 years ago." Again, on p. 450, we have this: "If, therefore, the glacial period should prove to have ended only 10,000 years ago, instead of 70,000, the Darwinian would be relieved of no small embarrassment."

A genuine scientist, of course, has no preconceived theory to sustain — whether of Darwin, or of Archbishop Ussher — he seeks only to know the truth, whatever may be the consequences. Perhaps the points mentioned in this paper further along have not had sufficient attention hitherto. "Come, let us reason together."

The first extract above sets the close of the "Ice Age" entirely too far back. One of the objects of this paper is to make good this assertion. From the facts set forth below, it is reasonable to conclude that even on Croll's theory alone the close was not over 40,000 years ago, and possibly not over 35,000. If the views of Professor LeConte, given in his paper of January, 1891, have the weight and influence which their importance demands, it seems to me that there need no longer be any contest between gacialists who reject the astronomical theory, by reason of the remoteness of the time, and those who refer the ice age to terrestrial causes alone. Professor LeConte's theory is so clearly and tersely set forth that it is best to quote it entire, as given by Professor Wright on pp. 618–9, including the figure used in illustration:—



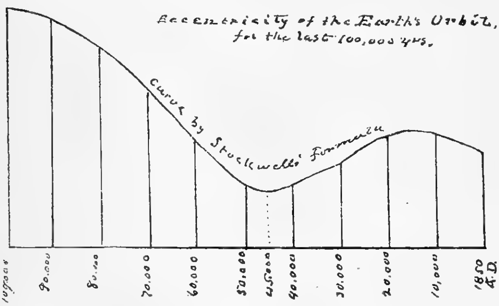
"1. That the continental elevation which commenced in the Pliocene culminated in the early Quaternary, and was, at least, one of the causes of the cold, and therefore of the ice accumulation.

"2. That the increasing load of ice was the main cause of the subsidence below the present level.

"3. That the removal of the ice-load by melting was the cause of the re-elevation to the present condition.

"4. That all these effects lagged far behind their causes.

"This lagging of effects behind their causes is seen in all cases where effects are cumulative. For example, the sun's heating power is greatest at midday, but the temperature of the earth and air is greatest two or three hours later; the summer solstice is in June, but the hottest month is July; and in some cases the lagging is much greater. The cause of sea-breezes,— i.e., the heating power of the sun, — culminates at midday, but the effects in producing air-currents culminate late in the afternoon and continue far into the night, long after the reverse cause, i.e., the more rapid cooling of the land, has commenced.



"Now, in the case under consideration, it is probable that the lagging would be enormous in consequence of the reluctant yielding of the crust and the capacity of ice to produce the conditions of its own accumulation. Although the elevation produced the cold, and therefore the ice accumulation, yet the latter culminated long after the former had ceased, and even after a contrary movement had commenced."

So far LeConte.

The close of the glacial epoch as above given — 70,000 years — is wholly arbitrary, and is evidently very far from the truth, as will be shown. At that time the eccentricity of the earth's orbit was nearly twice as great as it is now, and the consequent excess of the sun's time on one side of the equator above that on the other side (depending on the longitude of the perihelion) was about fourteen days. It had decreased from thirty-five, when the difference was greatest. But this difference of fourteen days would work in the direction of great difference of climate between the hemispheres, and would so continue to work as long as there was any difference at all. And not only so, but the effect would continue and accumulate according to the universal law of nature in the cases above cited, long after the smallest eccentricity had been reached. And that smallest eccentricity occurred less than 45,000 years ago, whether the computation be made by the formula of LeVerrier or by that of Stockwell.

The last sentence of the extract from LeConte is significant: "Yet the latter culminated long after the former had ceased and even after a contrary movement had commenced." In this latitude the usual temperature for the first week in December is not very different from that of the first week in March. Yet the sun in the first case is more than twenty-two degrees south of the equator, and at the latter date is scarcely five degrees. In like manner, and in accordance with the law above named, suppose the intense cold resulting from the wide glaciation of the northern parts of this continent, to have continued long after the eccentricity had reached its minimum, then it is not only possible, but even probable, that the close of the ice age was not more than 35,000 years ago, even if 30,000 would not be a more accurate designation. In which event, the objection to the astronomical theory, by reason of the long time elapsed since the days of high eccentricity, is wholly removed. And Professor Wright himself, although long favoring the short period of 10,000 years, has lately seen cause to doubt whether this is not too small. In a letter to the New York *Nation*, under date of Sept. 15, 1892, in view of his recent investigation of the old northern outlet of the great lakes into the Ottawa River, he says the facts "will . . . considerably lengthen our computation."

This throwing back of the close of the ice age by the glacialist, and the preceding shortening of the period in accordance with a universal law of nature, may both serve to strengthen the hypothesis of LeConte, and commend it to all interested in these questions, as the explanation which best accounts for the admitted facts.

CURRENT NOTES ON CHEMISTRY.—I.

[*Edited by Charles Platt, Ph.D., F.C.S.*]

Properties of Diamonds.

THE experiments of M. Moissan in the production of artificial diamonds and other precious stones, his remarkable results in the reduction of the most refractory oxides and his whole line of work at high temperatures, are well known to readers of the scientific magazines. Some of the more recent investigations have been of the properties of the diamond when heated in oxygen, hydrogen, chlorine, etc. When the temperature is raised slowly the combustion is correspondingly slow and without production of light, being recognized solely by the action of the gas evolved on baryta solution. At 40°–50° above the point at which this slow combustion takes place the combustion becomes more rapid, producing a visible flame. Yellowish-brown carbonado burned with a flame at 690°; black carbonado with a flame at 710°–720°; transparent Brazilian diamond without a flame at 710°–720°; transparent crystallized Brazilian diamond without a flame at 760°–770°; cut diamond from the Cape without a flame at 780°–790°; Brazilian bort and Cape bort without a flame at 790°, and with a flame at 840°; very hard bort without a flame at 800°, and with a flame at 875°. As a rule, the harder the diamond the higher its point of ignition.

When heated to 1200° in hydrogen the Cape diamond loses nothing in weight, but becomes lighter in color and less transparent; dry chlorine and dry hydrogen fluoride have no action at 1100°–1200°. Sulphur attacks diamonds at 1000°, but with carbonado carbon bisulphide is readily produced at 900°. Sodium vapor has no action at 600°. Iron at its melting point attacks the diamond with the production of graphite on cooling; melted platinum also combines readily. Fused potassium hydrogen sulphate and alkali sulphates, potassium chlorate and nitrate are all without action on the diamond, but, according to Damour, attack carbonado. The diamond is rapidly dissolved when heated to a high temperature with carbonates of the alkalies, carbonic acid being given off, but no hydrogen, and hence M. Moissan concludes that diamonds contain no hydrogen or hydrocarbons.

Treated with hydrofluoric acid, and then with aqua regia and finally washed, dried and burnt in oxygen, the diamonds yielded an ash consisting in all cases but one chiefly of ferric oxide. Cape bort contained also silica, calcium and magnesium, and Brazilian carbonado, silica and calcium, with a trace of magnesium. One specimen of green transparent bort from Brazil left a minute quantity of ash, which contained silica, but no iron.

Preparation of Pure Alumina.

The preparation of pure alumina from bauxite, which is always accompanied by more or less silica and oxide of iron, has commonly been carried out as follows: Taking advantage of that property of alumina, which enables it to act as either base or acid, according to its environment, the bauxite is fused with sodium carbonate, the resulting products being sodium aluminate and sodium silicate. The mass is then extracted with water and the sodium aluminate passed into solution. The silicate of soda, owing to a deficiency of base, is but little acted upon by the water and with the ferric oxide is left in the residue. From the solution of the sodium salt the alumina is precipitated by passing carbonic acid gas, carbonate of soda being regenerated at the same time.

This process has lately been improved by first precipitating a portion of the solution of aluminate by the gas in the cold, producing a small quantity of crystallized alumina hydrate of the same composition as Gibbsite, $Al_2O_3\ 3\ H_2O$. This, then, is added to the main bulk of solution, and a complete separation of the whole is secured, the soda being left in the caustic state. The reaction which takes place has been investigated by M. A. Ditte, and is explained as follows: A solution of sodium aluminate may be regarded as amorphous hydrated alumina dissolved in caustic soda. The form in which a body crystallizes from a solution is largely determined by the character of the crystal introduced to start crystallization. Hence in the process described above the tendency of the whole is to crystallize in the form of the several crystals first introduced, and as the crystalline form of alumina is less soluble than the amorphous in alkaline solutions, there is a gradual complete precipitation. Stirring facilitates the separation of the crystals by bringing those already formed into contact with fresh portions of solution. There is finally left only that proportion of alumina corresponding to the solubility of Gibbsite in caustic soda under the conditions existing.

Silk from Wood.

At the Paris Exposition in 1889 M. de Chardonnet gave to the world his process for the manufacture of silk from wood and received the highest honors from the jury of award. Since that time the process has been further developed and has presumably attained a practical success; silk is being manufactured at Besançon from wood pulp such as is used in the fabrication of certin kinds of paper According to F. B. Loomis, U. S. Consul at St. Etienne, the following process is used: The pulp is carefully dried in an oven and plunged into a mixture of sulphuric and nitric acids, then washed in several water-baths and dried by alcohol. The product thus prepared is dissolved in ether and alcohol with the production of collodion similar to that used in photography. This collodion, which is sticky and viscous, is enclosed in a solid receptacle furnished with a filter in the lower end. An air-pump supplies air to the receptacle, and by its pressure forces the collodion through the filter, removing all impurities. The collodion flows into a horizontal tube armed with three hundred cocks having glass spouts pierced by a small hole of the diameter of the thread of a cocoon as it is spun by the silkworm. The spinner opens the cock and the collodion issues in a thread of extreme delicacy. This thread, however, is not yet fit to be rolled upon spools on account of its viscosity and softness, being still collodion and not "silk." To obtain the necessary consistency the thread as it issues is passed through water, by which means the ether and alcohol are washed out and the collodion solidified and transformed into an elastic thread as brilliant and resisting as ordinary silk. The dangerous inflammability of this substance, as prepared above (two centimetres per second), has been reduced, according to the inventor, by passing the spun thread through a solution of ammonia, thus rendering it as slow of combustion as any other like dress material.

Up to January of this year none of the more important silk manufacturers of St. Etienne or Lyons had invested heavily in this enterprise, but all express confidence in the process and believe it is destined to figure largely in the commercial world.

New Method for Melting Points.

A. Potilitzin is the author of a new method for the determination of the melting points for substances melting below 450°, this being the highest temperature which a nitrogen-filled mercury thermometer can indicate. One end of a hard-glass tube, 5 mm. bore and 500–600 mm. in length, is drawn out to capillary fineness and the other is bent at right angles. The capillary is dipped into the molten substance, the melting point of which is to be determined, so that on cooling the tube is closed by a solid plug of the substance 3–4 mm. long. The other end is connected with a manometer by means of which a pressure exceeding that of the atmosphere is maintained within the tube. The tube, along with the principal thermometer and also one for stem correction, is inserted into a wide test-tube, which is then immersed in a bath of fusible metal. When the melting-point is reached the plug softens and is expelled by the internal pressure, so that the sudden equalizing of the pressure in the manometer indicates the moment when the substance melts, the thermometers being then read off. Potassium nitrate was found by this method to melt at 336.57° (mean of eight experiments); by immersion of the thermometer direct into a large mass of the salt the melting point was found to be 336°.

Pigments Used in Some India-rubber Toys.

India-rubber has been generally, and correctly, accepted as a suitable material for children's toys; but investigation into the manufacture of the latter reveals the fact that many as placed upon the market contain harmful ingredients. A. Bulowsky has recently called attention to several dangerous ingredients as, for instance, in black dolls, which are often colored "in the mass" with lead pigments. Red articles are also most usually colored in mass, the pigment being antimony sulphide, which, however, being unattacked by the saliva may be considered innocuous. Grey rubber goods generally contain zinc oxide, and hence particularly when, as is sure to be the case, the toy is brought to the child's mouth, an element of danger is introduced. Superficial coloring is frequently accomplished by means of poisonous pigments. These remarks are applied in particular to foreign manufactures, and though, doubtless, the same coloring matters are used in this country, I have yet to learn of a case of poisoning from coloring in mass. Superficial pigments, from their disposition to flake and from the greater quantity brought into contact with the mouth, are certainly to be avoided. It is difficult, moreover, to estimate the amount of damage done by these toys owing to the many petty ills and derangements of infancy, the poison received by the child very likely is insufficient to develop well-defined symptoms or to direct suspicion, but at the same time may be the cause of an indisposition which itself brings on crying, wakefulness, and general wear on the little body struggling for existence.

NOTES AND NEWS.

PROFESSOR E. W. DORAN has been elected president of Buffalo Gap College, Buffalo Gap, Texas, and has resigned his position at College Park, Md.

— C. H. Turner has resigned his position at the University of Cincinnati and accepted the Chair of Natural History at Clark University, Atlanta, Ga.

— P. 21, line 9, from below: "regristation," read "registration;" p. 22, line 15, from below: "possible," read "impossible;" and p. 22, column 2, line 31, from above: "understood," read "understand."

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

THREE SHIPS WITH BERIBERI OUTBREAKS SHOWN TO HAVE HAD EXTENSIVE FORMATION OF CARBONIC OXIDES DURING THE VOYAGE—ANALYSIS OF BERI-BERI BLOOD—CONCLUSION THAT BERIBERI IS NOTHING BUT CARBONIC POISONING OF THE BLOOD.

BY ALBERT S. ASHMEAD, M D., NEW YORK, N.Y.

In *Science*, Nov. 18, 1892, I contributed an account of the outbreak of beriberi on board the bark "H. B. Cann," from Ilo-ilo, Philippine Islands, with a cargo of raw sugar. That cargo fermented during the trip, stifling fumes filled the ship, and the beriberi outbreak was considered the consequence of this state of things.

In an article which will shortly appear in the *Medical News*, entitled "Investigation of the Outbreak of Beriberi on Board the Bark 'Pax' from Ceylon with a Cargo of Graphite," I show that, from the deficient packing of 1,200 tons of graphite, the cargo was exposed to the moist air encountered on a tropical voyage, all but six of a crew of nineteen were stricken with beriberi.

The bark "J. C. Warns," from Java and Macassar, with a cargo of green coffee, arrived in New York June 23, 1890. The captain and three men had died of beriberi. The coffee had been picked and shipped too green. Mr. Tobias, consignee of the cargo, showed me a sample of it; it was charred, carbonized, and almost destroyed. The coffee had fermented. The outbreak of beriberi on a ship from Java, where the coffee has been carbonized, is a regular occurrence. Java coffee owes its value in our market to its color; in order to obtain this color, the captains take their cargoes quite green, which favors a slight fermentation during the trip. Sometimes they go too far; the coffee is too green, and the fermentation too violent; in such cases there is always carbonization; the grains stick together in great masses, and abundant fumes (carbonic gases) fill the ship.

The iron ship "Glenmorag," Captain Currie, 133 days from Colombo, Ceylon, with 1,100 tons of graphite on board, 800 tons of cocoa-nut oil, etc., arrived July 17 in New York. This ship, loaded in Colombo alongside the "Pax" (mentioned above), travelled the same course, at an interval of two weeks. She lies now at the Atlantic dock, in Brooklyn, again alongside the "Pax." She had no beriberi outbreak. From her first mate I have the following information:—

Crew, 28 men; captain's wife and two children on board; or all, 31.

She is a Scotch Glasgow boat, and the crew is English and Scotch. Before taking this cargo, this ship had carried from Barry Dock, near Cardiff, a cargo of coal to Buenos Ayres, South America, and taken a ballast of sand to Colombo, Ceylon. Before these trips she had been in the wheat trade from Tacoma, Washington, to Havre, France. She is remarkably dry, and the cleanest ship one would wish to see. I went down her hold and examined every part of it; there is not a smut nor a stain anywhere about it. The iron part is especially clean: no trace of incrustation of carburetted iron, which might have indicated the action of hot moist air on the carbon. None of the barrels containing the graphite was broken. The packing was exceedingly good, the dunnage consisted of sticks and cocoa-nut hulls, so that it was impossible for the barrels to roll and break, and thus expose their contents to the action of the air.

The diet bill was about the same, or even poorer, than that of the "Pax." Nine casks of salted beef and seven barrels of pork were consumed during the trip. Fresh beef (tinned) three times a week, one-half pound to a man, and a half pound of salt meat on the same days; other days a full pound of salt meat a day. One-half pound of rice for each man on Saturdays; no vegetables except onions with the soup three times a week. The ship being Scotch, oatmeal made part of its fare for two and a half months after starting, when it ran out. No sickness whatever during the voyage. One death by accident. The captain attributes the good condition of his cargo and his crew to the change of winds and cooler weather which he enjoyed from the Cape of Good Hope to the North Atlantic. His log is indeed very different from that of the "Pax."

In *Science*, vol. xxii., No. 545, p. 16, Venable states that "the metallic carbides are usually formed by the action of intense heat upon the metal in the presence of carbon. The form of this carbon is capable of being greatly varied. Graphite, amorphous carbon, and many hydrocarbons, may be used. The heat of the ordinary furnace is sufficient to form the carbides of the metals already mentioned, zinc, copper, and notably iron. All of these carbides, under certain conditions, give off their carbon in the form of hydrocarbons. The same smell can be detected in all during their decomposition. In some cases, as iron and zinc, the decomposition is caused by the action of an acid. The carbides of the earths (*of which graphite is one, in conjunction with iron*) decompose in moist air, and more rapidly in water."

I may point again here to those broken barrels of the "Pax," which exposed the carbon to the influence of tropical air.

I have examined microscopically the blood of four of the sufferers of the "Pax," and obtained the following results: Captain Geeseicke, sick since May 16 with beriberi; 800 diameters, $\frac{1}{12}$ inch oil-immersion objective; red discs, irregular in outline, congregated in masses, with ragged edges, not inclined to form rouleaux; quite plastic; colored streaks or rays of pink and red, showing the presence of biliary matter, biliverdin crystals; black spores, not free but entangled in the hummocks of corpuscles. It may be noted that the oedema of this patient's legs only left him two days before this examination.

Henry Oelrichs (second mate), German, 27 years old. Has been fourteen days sick with beriberi. Examination of the blood: 500 diameters, $\frac{1}{8}$ inch objective; red corpuscles, very plastic, aggregated in hummocks. Many black spores are seen floating about, free in motion. Fibrine in excess, light in texture, and lumpy. Blood very thick, syrupy, and plastic. No motion, showing want of circulation. Excess in the coloring matter. This same case examined: 900 diameters, $\frac{1}{16}$ inch objective immersion lens, shows excess of fibrine in ropes, biliary matter in great excess; no crystalline formations; blood quickly oxidizes and forms a solid mass. The black spores above mentioned are quickly held by the fibrine; the red discs are distended, bladder-shaped, and have very ragged edges. The meniscus-shape is lacking, there being great irregularity in outline and color, some are even square-shaped. Some discs have an excess of color, some are very pale. On the edges of the corpuscular mass the color quickly disappears, in consequence of rapid coagulation.

Isaac Hegglund, a Swede, 27 years old, has had beriberi since crossing the equator, six weeks ago. Legs are now very thin, but still some soreness remains; knee reflexes still lost. First sound of heart prolonged. Microscopical examination of the blood, 900 diameters, $\frac{1}{16}$ inch objective, shows rouleaux well formed, no spores, no filaments, slight feverish condition shown by spiculated outlines of some of the red corpuscles. Fibrine is assuming a normal form, showing meshes very regular; no distension of red corpuscles.

Emil Jensen, a German, 19 years old, sixteen days sick with beriberi. Black spores in active motion and very plentiful; freely scattered in the field of observation; circulation very torpid; fibrine very irregular, light in texture; biliary matter freely scattered; blood discs distended and with ragged edges; red corpuscles congregated in masses; fibrine forming in heavy clots; blood rapidly coagulating; black spores are quickly fastening in the fibrine.

We have here, in the 14th day sick and the 16th day sick cases, black spores in active motion and biliary matter in both cases, and the corpuscles distended bladder-shaped, in ragged-edged condition; the fibrine quickly clotting. And in the captain's case, which was the worst of all, we have still black spores, biliary matter, and ragged-edged corpuscles.

In the 6th week case, a much milder case, moreover, than any of the others, it is reasonable to assume that in some way the patient has quickly eliminated the poison. There is no biliary matter in his blood, no black spores, no abnormal fibrine, no distension of red corpuscles; the latter are perfectly formed in rouleaux.

Examinatian of urine of Henry Oelrichs (second mate, bark "Pax"), July 17th, 1893 (14th day of beriberi):—

Odor, light, aromatic, and feverish.
Color, light (yellow) amber.
Reaction, excessively acid.
Appearance, transparent.
Specific gravity, 1.032 +.
Weight of a fluid ounce, 470.27 grains.
Solids in a " " 35.06 "
Nature of deposit, mucus.
Quantity of deposit, trace.
Bile, coloring matter not present.
Salts, " "
Sugar, Fehling's solution, trace.
Chromate solution, "
Nylander's solution, "
Sacchrimeter grammes in a litre, 0.00 +.
Albumen, nitric acid, 1 fl. ℥, not present.
Picric solution, trace.
Touret's solution, "
Bichromate solution, not present.
Bichloride solution, trace.
Millard's solution, "
Polariscopic grammes in a litre, 0.00 +.
Microscopical appearances:—
Pus corpuscles, trace in quantity.
Epithelium, bladder, trace in quantity.

Quantitative examination:—

Urea, proportion per fluid ounce	6.605 grains.
Percentage of	1.404
Total, quantitative examination	66.050 grains.
Chlorine	.960 grains.
	204
	9.600 grains.
Sulphuric acid	.992 grains.
	210
	9.920 grains.
Phosphoric acid	1.024 grains.
	201
	10.240 grains.
Carbonic acid gas	1.120 grains.
	237
	11.200 grains.

Results on a net basis:—

Urea	1.40
Water	95.00
Sugar	0.00 +
Foreign	2.76
Albumen	0.00 +
Chlorine	.20 +
Sulphuric acid	.21
Phosphoric acid	.20
Carbonic acid gas	.23
	100.00

Traces of sugar and carbonic acid gas are commonly observed in the urine of beriberi patients.

Dr. Wallace Taylor, Osaka, Japan, sends me three interesting tables, which he made from examinations of 134 cases of beriberi. These examinations were made with Hayem's hæmatometer and Gower's hæmacytometer. The average corpuscular richness for the 134 cases is 94 per cent. This, he says, corresponds to the clinical experience in cases of beriberi. Most of the cases of beriberi seen by the general practitioners are well-fed, well-nourished, full-blooded appearing men. The ill-fed, poorly-nourished, weak constitution cases are the exception. During the past few years he has kept a record of the physical condition of the beriberi patients, and he gives this record, together with another record, of a beriberi hospital in Tokio:—

	Taylor.	Beriberi Hospital.	Sum.
Of strong constitution,	323	593	916
" average "	15	27	42
" weak "	9	6	15

Thus, in a total of 973 beriberi patients, there were 94 per cent of strong constitution (a result almost identical with that given in his tables), and only 6 per cent of average and weak constitutions.

"These numbers," says Taylor, "are large enough to be conclusive, and anæmia is not one of the pathological conditions of beriberi."

In his table No. 3 there is shown a general diminution of the hæmoglobine. The average hæmoglobine in 101 cases is 81 per cent. In some of these cases the amount is very low, being below 65 per cent, and with but few exceptions the per cent of hæmoglobine is below the per cent of corpuscles, showing a deficiency of the individual corpuscles in hæmoglobine.

The appearance of biliary matters, which I have shown in my analyses of the four cases of the bark "Pax," would show by itself a deficiency of hæmoglobine.

In the *Tribune Mèdicale*, Sept. 10, 1891, Messrs. Bertin-Sans and Moitessier show that it is the presence of hydrogen and carbonic acid in oxicarbonized blood that prevents the total destruction of hæmoglobine.

By sweeping their solution of oxicarbonized blood and water, with a current of hydrogen and carbonic acid gas, and an addition of sulphide of ammonia, they obtained the spectrum of reduced hæmoglobine. They thus show that oxicarbonized hæmoglobine can be readily transformed into a mixture of methæmoglobine and oxide of carbon. It is therefore reasonable to suppose that in an outbreak of beriberi where we have the presence of oxides of carbon and a deficiency of hæmoglobine (observable in all cases of beriberi) the latter is the effect of the former.

In Japan, the universal burning of charcoal produces the oxides, which held down in the low places by the moist atmosphere of the beriberi season, there is produced on a large scale and continually during the moist season what happens on board of each of those ships which come to us from the East with carbonized cargoes and beriberi-sick crews.

THE STRUCTURE AND AFFINITY OF THE PUERCO UNGULATES.

BY CHARLES EARLE, B. SC. (PRINCETON).

The discovery in 1880 by Baldwin of the presence of mammalian remains in the Puerco beds of New Mexico, was one of the most important in the history of vertebrate paleontology in this country. This rich mammalian fauna has been wholly described by that able investigator, Professor E. D. Cope, and to him we are indebted for having made known to the scientific world the interesting mammals which are imbedded in this formation.

As I have lately been studying a collection in the American Museum of Natural History from the Puerco, I propose in this paper to sum up some of the results of my investigations as relating in particular to the primitive ungulates of this formation, and especially to attempt to place some of these forms in or near their proper phylogenetic positions in the system.

As a word of introduction I would remark that most of the remains from the Puerco are in a poor state of preservation, and this applies particularly to the skeleton. The teeth are often well preserved, so that in working out the affinities of these mammals we are generally dependant upon the character of the teeth to discover their relationship to other forms. A very striking peculiarity in the dentition of the Puerco mammals, as pointed out by Professor Cope, is the fact that their superior molars are generally of the tritubercular pattern, and these upper teeth are associated with inferior molars, which are tubercular-sectorial, or a modification of the latter. In the tubercular-sectorial tooth the anterior portion is raised above the posterior or talon, and consists of three elevated cusps. By the modification of the latter pattern of molar, both the highly specialized sectorial teeth of the Carnivora and the quadritubercular teeth of the Ungulates have been derived.

In general we may say that, besides the characters of the teeth, the mammals of the Puerco epoch, in their skeletal structures, as far as known, are of a decidedly primitive type. The skull is short and heavy, with the orbit well forward over the teeth; the various processes of the skull for muscular attachment are prominent. Correlated with their low structure in general was the exceedingly small brain, as illustrated by the genus *Periptychus*. As the structure of the skeleton in the latter genus is the best known, I will enumerate some of its characters. The feet of Periptychus were plantigrade. The hind foot had five toes, the external one being not much shortened. The structure of the astragalus is well known in Periptychus and important, as teaching us one of the characters of the structure of the primitive foot in general. This bone is short and strongly depressed; the neck of the same is short and heavy. In all modern mammals which are digitigrade the trochlear surface of the astragalus, articulating with the tibia, is deeply grooved, whereas in Periptychus this surface is plane and flat. Another very important and primitive character of the astragalus in Periptychus is that it is perforated by a well-marked foramen. I am not aware that this perforation of the astragalus occurs in any recent Ungulate. The astragular foramen is of constant occurrence in Puerco mammals and also is present in some of their descendants in the Wasatch (*Coryphodon*).

In one respect the foot of Periptychus is more advanced than that of the genus *Phenacodus*, which is from a later formation (Wasatch); I refer to the articulation of the cuboid bone with the astragalus, but in general the foot structure of Phenacodus is far advanced in its evolution over that of Periptychus. Phenacodus was a digitigrade mammal, with the outer toes much shorter than the median. The long bones of the skeleton in Periptychus are short and heavy; this applies particularly to the humerus, which is an exceedingly heavy bone; its distal extremity is perforated by an entepicondylar foramen, another primitive character of this genus. The character of the humeral condyles in Periptychus is peculiar and different from all modern Ungulates. In the latter group the trochlear surface of the humerus is interrupted by a strong ridge separating the external from the internal articular surface. Now in Periptychus, as well as in Phenacodus, there is no such interruption of the condylar surface of the humerus, and it has the same character as in the modern Carnivora, thus showing how these two widely separated orders at the present time approach each other in their osteological characters in the Eocene. The ulna and fibula are large in Periptychus and more nearly approach the size of the bones of the preaxial side of the limbs than in modern forms.

Now the question arises, what great groups of mammals of later epochs than the Puerco are represented in this formation. I think that we may safely say that there were only a few main stems of Puerco mammals which persisted until later periods, and I shall endeavor to show that these stem forms were the direct ancestors of later types. As in so many cases, in seeking to determine phylogenetic relationships, we must turn to the investigations of Professor Cope to decide this question in part at least. He has described mammals from the Puerco which he considers to be Ungulates in their affinity, others to be related to the Carnivora, and still other types which resemble the Lemuroidea in the structure of their teeth. As I am only dealing with the Ungulates in this paper I shall speak of certain genera which Professor Cope and other paleontologists have determined to be closely related to this group.

The group of primitive Ungulates which Professor Cope has designated the Condylarthra is not a very homogeneous one, it appears to me, and perhaps with Schlosser we had better speak of a condylarthrous stage, through which all Ungulates are supposed to have passed rather than to attempt to confine these early forms all in the suborder Condylarthra. At least as shown by Professor Osborn, the characters laid down by Professor Cope as limiting the Condylarthra, would not include some of the forms (*Periptychus*) which Professor Cope has embraced in this suborder.

When we attempt to separate the Ungulates from the Unguiculates of the Puerco we are met with the obstacle that in most cases the distal phalanges of the feet have not been preserved. Accordingly we are dependant upon the character of the dentition to diagnose and separate these two groups. However, so low down geologically speaking as the Puerco, the different groups of Ungulates are not supposed to be distinctly differentiated, and then again in most cases the structure of the skeleton, and especially of the carpus and tarsus of these forms, is totally unknown. I believe, however, that the stems leading to the main types of the Ungulates which we meet with in the Wasatch, are fairly well separated in the Puerco, and more so than has been generally accepted. For example, when we consider another group other than the Ungulata, the Creodonta, we find a number of well-marked families of this order in the Puerco, which are distinct and lead up in some cases to types of later epochs. The Creodonta, with low-crowned, purely bunodont teeth, such as are included in the Triisodontidæ, the more specialized and trenchant dentition of the Provivirridæ (*Deltatherium*), and again the low-crowned and nearly quadritubercular lower molars of the Arctocyonidæ (*Claenodon*, Scott). The last-named genus is very likely the ancestor of the Wasatch (*Anacodon*).

Turning again to the Ungulates, what are the types of this order which we can distinguish in the Puerco? To attempt to decide this question we must rely on the characters of the teeth in nearly all cases. To ascend to the mammals of the Wasatch period for a moment we observe in that formation the Perissodactyles are distinct from the Artiodactyles. The former group has superior molars with six cusps, which may be either distinct or fused; the lower molars are quadritubercular. In the Artiodactyles of the Wasatch the superior molars are of the tritubercular pattern and the lower teeth are sexitubercular, or more nearly of the primitive tubercular-sectorial type already mentioned. Again, the premolars of the Perissodactyles are more complex than these of the Artiodactyles. Returning to the Puerco we find the same state of things well foreshadowed, although these two stems may have not passed the condylarthrous stage. In the genus *Euprotogonia* (= *Protogonia*), we have the supposed condylarthrous representative of the Perissodactyles, and in the genus *Protogonodon* of the Puerco I believe we are dealing with an ancestral Artiodactyle. I am aware of the fact that the skeletons of these two genera are totally unknown, so until they are discovered we will be unable to say whether these two forms were true Condylarthra or if they had assumed more of the characters which are typical of the two great divisions of the Diplarthra. I think that from a study of the teeth of the above genera that the two lines of the Diplarthra were fairly well separated even in the Puerco.

The upper true molars of Euprotogonia in the typical form, *E. puercensis*, consist of six tubercles. The superior premolars are simpler than in Phenacodus. A character of the upper molars of Euprotogonia, and separating it well from Phenacodus, is the absence of the parastyle and mesostyle. When we study the structure of the lower teeth in Euprotogonia, we are surprised to find them so highly developed for a Puerco form. The last lower premolar is nearly as complex as it is in the Wasatch Phenacodus, and in the typical species the crescents of the inferior true molars are as plainly marked as in the last-named genus. In the supposed ancestors of the Artiodactyles from the Puerco (*Protogonodon* and perhaps other genera, as suggested by Professor Scott) the characters of the dentition are well differentiated from those leading to the Perissodactyles. I have referred upper teeth in the American Museum collection to Protogonodon, which are of the tritubercular type, with exceedingly brachydont crowns. These upper teeth differ considerably from those of the bunodont Creodonta. The internal cones and intermediate tubercles in Protogonodon have coalesced and nearly form crescents. The external cusps of these superior molars are depressed and not as conical in section as in the Puerco Creodonta. The lower true molars of Protogonodon are sexitubercular, but differ in form from those of most of the Creodonta by the fact that the anterior portion of the tooth (trigonid) is not raised above the posterior (talon). The cusps of the lower true molars, as in the case with those of the upper molars, coalesce and form continuous tracts of worn enamel; this applies particularly to the posterior limb of each crescent. Lastly, the upper premolars in Protogonodon are not yet known, but the lower teeth of this series are well preserved and shows them to be absolutely simple in structure, consisting of a cone with slightly enlarged heels. In some specimens there is a trace of an internal cusp on the last lower premolar.

The characters above adduced as pertaining to the dentition of Protogonodon approach closely those of the earliest known American Artiodactyle, viz., *Pantolestes* from the Wasatch Eocene, I would suggest accordingly that *Protogonodon* may stand in ancestral relationship to this genus.

I do not agree with Dr. Schlosser in deriving the Artiodactyles from any of the known Periptychidæ, as the latter group has been defined by Professor Cope. In nearly all of the Periptychidæ the premolars are highly specialized and are not adapted for further evolution. Professor Scott, in his very valuable paper on the "Creodonta," only recently published, has subdivided the genus *Mioclaenus* Cope into several new genera, limiting the latter genus for a few species only; the type being the *Mioclaenus turgidus*. The structures of the premolars in Mioclaenus are more like those of some of the Periptychidæ than the Creodonta, and consequently Professor Scott believes that Mioclaenus is a condylarth. Other than the genera already mentioned as probably having been persistent types, I would intimate that *Mioclaenus turgidus* may stand in ancestral relationship to some of the White River bunodont Artiodactyles (*Leptochœrus*). The following phylogenetic scheme may illustrate the affinities proposed in this paper:

Perissodactyla.	Bunodont Artiodactyla.	Selenodont Artiodactyla.	Amblypoda.
|	|	|	|
Euprotogonia.	Mioclaenus.	Protogonodon.	Pantolambda.

DO THE LEAVES OF OUR ORDINARY LAND PLANTS ABSORB WATER?

BY EDWARD A. BURT, EAST GALWAY, N.Y.

CONFLICTING answers have been given to this question. Hales, Boussingault, and Henslow concluded from their experiments that leaves do absorb water; other investigators have failed to obtain such positive results, and have been inclined to doubt absorption. Furthermore, the theory that the transfer of liquids is largely accomplished through differences in density of the liquids in the plant caused and maintained by transpiration from the leaves — this, by giving a sufficient function to the leaves, has probably deterred investigators from entering upon an inquiry that promised only negative results, and that was beset with difficulties in carrying out. Yet a moment's reflection shows us that during the growing season of several months in each year, our vegetation is covered with dew night after night, and often when periods of drought prevent the plants from receiving an adequate supply of water through their roots. Does it not seem probable that plants are able to use the dew which covers their leaves?

Under the direction of Professor Goodale and Mr. W. F. Ganong, the writer has been recently carrying on a series of experiments in the botanical laboratories of Harvard University to determine —

(*a*) Whether it is probable that leaves do absorb water.

(*b*) Whether the conditions under which such absorption occurs, if it does occur, will not afford suitable ground for more special investigation later on.

Some of the results already reached seem to justify a preliminary publication.

Can Leaves Absorb Water?

To decide this, young branches of Diervilla grandiflora, common house geranium (Pelargonium), and Mesembryanthemum were cut from the parent plants while in full leaf. The clean-cut ends of these small branches were then dipped into a waterproof varnish — Brunswick black — so as to completely cover the cut ends and the sides for an eighth of an inch up the stem. The branches were then allowed to lie on a table in the laboratory — temperature, 70° F. — for a time until wilting occurred. They were then weighed, sprinkled with water, and shut in a botanist's tin collecting-box for from 16 to 46 hours. Having recovered their original fresh condition, the branches were then removed from the box and dried carefully from adhering water by exposure to the air of the room and by the use of blotting paper. They were then weighed. In each case there was an increase in weight indicative of absorption. The details are given in the following table: —

	Period of wilting.	Weight of wilted branches.	Time shut in the box.	Weight of water absorbed.
	Hours.	Grammes.	Hours.	Grammes.
Diervilla grandiflora................	3	12.12	16	0.36
Common geranium (Pelargonium).	49	26 79	46	5.76
Mesembryanthemum (a succulent-leaved plant)	49	40 55	46	0.77

Henslow obtained absorption with cut branches in a large number of cases and under a variety of conditions; but as he did not cover the cut ends of his branches, it has been objected that the absorption in his experiments occurred through the cut ends rather than through the leaves. My experiments show that the objection was not well taken. We must conclude that slightly wilted leaves may absorb water.

Do Leaves of Rooted Plants Absorb Water?

Small vigorous-growing plants of Ricinus and of a small-leaved Begonia were used. They were obtained from the greenhouse in 2- and 3-inch pots. The pot and the lower portion of the stem of each plant were then inclosed in a covering of sheet rubber in the following manner: A small circular opening of less than half an inch in diameter was cut in the centre of a piece of sheet rubber of suitable size. The rubber was then stretched in the region of the opening so as to make the aperture temporarily larger. The pot was then slipped down through this opening.

Upon lessening the tension, the rubber contracted clasping the stem just below the lowest leaves. With a stout thread the rubber was then wound firmly against the stem for a sufficient distance to make a close contact of the two. With its centre suspended from the place where tied about the stem, the rubber now hung down covering the pot loosely and completely concealing it. The lower portions of the rubber were now gathered together underneath the pot and firmly tied together with strong cord.

A thrifty young begonia plant with its pot so covered had its leaves thoroughly sprayed with water by means of an atomizer at 6 P.M. It was then placed under a large bell-jar in an atmosphere made and kept damp by wetting the inner surface of the jar with water and by suspending in the jar two large sponges dripping wet. With its leaves wet, the plant was kept in this damp atmosphere in the dark during the night. In the morning it was removed from under the bell-jar, dried carefully, and then weighed at 8.40 A.M. It had increased its weight 0.09 grams during the night. This increase must have been due to absorption of water by the leaves.

At 8.40 A.M. the bell-jar was removed to a window space and the damp atmosphere was obtained within the jar as before. The leaves of the plant were then thoroughly sprayed again and the plant was placed under the jar and left there in a strong light during the day. From time to time, as the water began to disappear from the leaves, they were resprayed. At 4 P.M. the plant was removed from the moist chamber and carefully dried. It was then weighed and showed a loss in weight since 8.40 A M. of 0.41 grams.

On repeating the experiment with the same plant, the increase in weight was 0.04 grams during the night—from 6.15 P.M. to 8.20 A.M. From 8.20 A.M. until 2.30 P.M., there was a decrease in weight (transpiration) of 0.23 grams.

But was the increase in weight during the night in these experiments really due to absorption of water by the leaves? May not the moist air surrounding the plant have passed through the rubber covering and deposited some of its moisture upon the earth or pot, thus giving absorption by the earth rather than by the leaves? Such an interpretation of the experiment is forbidden by the condition of the interior found upon opening the rubber covering at the close of the confirmatory experiment. (That condition was not *precisely* known while the experiments described were in progress, for the plant had been subjected to experiments for several weeks, during which time its growth had made it difficult to give to the plant amounts of water exactly equal to the amounts transpired from day to day). Upon opening the rubber covering, the earth in the pot was found wet to the touch, the pot was wet, and the whole inner surface of the rubber covering was wet. In this condition of things, the greater movement of the water must have been from within the pot *outward* through the rubber to its dry outer surface and the drier—comparatively drier—air surrounding it in the moist chamber. If such a movement of water did occur, its effect was that of diminishing the weight of the plant during the night. We must regard absorption by the leaves as the cause of the increase which really occurred.

How potent a factor light is upon the functions of the plant, is readily seen by a comparison of the changes in weight during the day in these experiments with the changes during the night. At night, in the darkness, absorption perceptible by the balance occurred; during the day, transpiration predominated although the leaves of the plant were kept wet with water and in a moist atmosphere. Is it not possible that some of the failures to find absorption by leaves may have come through nice quantitative experiments having been carried on in the daytime, as would be the more convenient?

In conclusion, the experiments so far as they have been carried, seem to show—

(*a*) That leaves may absorb water.

(*b*) That leaves of growing plants do absorb water during the night when they are wet with water and in a moist atmosphere —i.e., under dew conditions.

INDIVIDUAL SKELETAL VARIATION.

BY FREDERIC A. LUCAS, U. S. NATIONAL MUSEUM, WASHINGTON, D. C.

The subject of individual skeletal variation is one of considerable interest, to the morphologist from the hints it may give concerning lines of descent, to the systematic zoölogist from its bearing on the specific units of classification and to the vertebrate paleontologist since he must mainly rely upon more or less fragmentary skeletons for the determination of species.

External variations are readily perceived, often easily accounted for by known conditions of environment, but the question how much may the skeleton of a given species normally vary is by no means easy to answer.

Unfortunately the problem is rendered all the more difficult from the fact that the large series of specimens necessary for its solution are seldom available, so that characters may be considered of specific value, or, on the other hand, as mere abnormalities, when they are really normal variations or, perhaps, due to changes brought about by age. The following notes are somewhat desultory in their character, but they are based on the observation of considerable series of individuals of the various species referred to, and are brought forward as suggesting the existence of a large amount of individual skeletal variation.

In the report of the U. S. National Museum for 1887–88, the writer gave at some length the results of the examination of a large series of bones of the Great Auk, a series that was particularly interesting from the fact that it represented adult individuals from one locality and one epoch, so that any variations might be considered normal, and not due to differences of environment, or to modifications that might gradually come about in the course of time, even were there no change in surrounding conditions.

It may be briefly said that the long bones were found to vary to the extent of one-fifth of their length, but that the most interesting variations in the skeleton were the tendency to develop a ninth, extra pair of ribs and the frequent presence of a small tubercle on the tarsus, just where a hind toe would be located.

Very nearly one sacrum out of every seven possessed facets, showing the former presence of an abnormal number of ribs, while but one-twelfth of the tarsi showed the little tubercle referred to.

Professor Newton found almost equally great variability in the bones of the Dodo and Solitaire, birds of unusually restricted habitat, but this he ascribes very largely to the fact that the remains examined probably represented individuals from very different epochs.

Among mammals the Orang seems to exhibit an unusual tendency to variation, and a series of crania of this animal shows many individual peculiarities.

Doubtless these are shown by other portions of the skeleton as well, but, at the time a large series of Orangs was available, my attention was directed almost entirely to the skull, and it can only be said that this species has considerable range in point of size, adult males being from four feet to four feet eight inches in height.

The Orang is a striking example of the cranial changes brought about by age, these being so great that four species have been founded on characters which a sufficient number of specimens shows to be due to age alone.

Apart from these it may be said that the foramen magnum has hardly the same shape in any two skulls, while the nasals vary as much, being sometimes long and narrow, sometimes short and broad, and in one case quite absent.

The shape and size of the orbits is very variable and they may be close together or some little distance apart. At the same time the supra-orbital ridges are often larger in rather young Orangs than in very old individuals.

A rather curious feature in the Orang is the tendency to develop an extra molar, the normal number being three, as in man. Usually this additional tooth is in the lower jaw and unpaired, but one jaw possessed four perfect molars on either side.

Our Mule Deer shows great cranial variability, both in size and proportions, and while typical skulls of the Mule Deer, the Columbia Deer, and Virginia Deer may be recognized at a glance, in many instances, where the antlers have been shed it requires careful examination to distinguish the skulls of the species apart.

The tendency to develop an extra pair of ribs is not very uncommon among birds, and, as we know, is occassionally seen in mammals, where it may take the form of a short pair of ribs on what would normally be the first lumbar, much more rarely a rib, or pair of ribs, on the seventh cervical, and sometimes that of an unpaired rib on the first lumbar.

In cases of this last mentioned variant the odd rib is usually longer than when an extra pair of ribs is present.

The true sacrals of birds are ordinarily devoid of parapophyses, in fact this is one of their distinguishing characteristics, yet among Cormorants these processes are not infrequently present and I have once observed them in a Goatsucker.

Although it is not uncommon to meet with an additional pair of ribs among birds, any lessening of the normal number is very rare and only once has such a case come under my notice, this being a common Cat Bird in which the haemapophysis had disappeared from the first dorsal rib, the true ribs being thus reduced to five in number.

It is quite possible that reduction in the dorsal region has been carried almost to its utmost extent among birds and existing facts seem to support this theory.

Among the highly specialized Passeres, the normal number of ribs, counting as the first the most anterior that is connected with the sternum, is uniformly six.

Close to the Passeres stands the heterogeneous group of birds termed Picariæ, many of which are doubtless survivals of the ancient forms from which the Passeres have been derived.

If this be the case the line of descent of these Picarians is a long one and in many respects they may have undergone more modification than their more recent relatives.

Certain it is that in this group we find, with very few exceptions, those birds having the smallest number of ribs, sometimes only five pairs, and at least once, in our Night Hawk, only four.

In the Swifts, near relatives of the Goatsuckers, it is not asserting too much to say that we can actually see the process of rib reduction going forward, for among these birds we find many specimens with six pairs of ribs, rarely one with seven, and in the majority of cases six complete pairs of ribs and the lower portion of a seventh, and this lower rudiment is present in varying proportions.

Lower in the scale, among the Amphibians, the number of vertebræ is inconstant, even in such species as *Necturus* and *Menopoma*, whose pre-sarial vertebræ are fewer in number than in any mammal.

Necturus may have eighteen or nineteen pre-sacrals, *Menopoma* nineteen or twenty, *Siren* forty-one, forty-two or forty-three, and *Amphiuma* sixty-four or sixty-five.

Variation in the number of caudals is, of course, to be expected, but in the long-bodied *Siren* and *Amphiuma* it may amount to as many as five or six vertebræ.

A curious variant has been noted in the sacrum of *Menopoma*, which Huxley, in the last edition of the Encyclopædia Britannica, describes and figures as composed of two vertebræ.

Unfortunately the specimen on which the figure and description are based was abnormal, for, like the Salamanders, *Menopoma* has normally but one sacral, and an intermediate condition, a *true* abnormality, may exist of ten vertebræ connected with the ilium on one side and one on the other.

It is evident from the instances just related that a considerable amount of individual variation in size, proportion of various bones, or even in the presence of certain bones, may exist in a given species.

Differences of size, unless excessive, are of little value, provided the parts retain their relative proportions and in judging of differences of proportion the question of age must be taken into account also.

Broadly speaking, variations are of two kinds, due to modifications of development or of structure, and the importance of any departure from a given type depends very largely on the answer to the question, to which of these two categories does the variation belong.

Modifications of development produce individual variations of size and strength, length of limb and power of jaw, modifications of structure—when *constant*—give rise to specific, generic or ordinal distinctions, as the case may be.

In the occasional extra molar of the Orang the extra ribs of birds, the tarsal tubercle of the Great Auk, and the varying number of vertibræ in Amphibians we have variations of structure that, being inconstant, have no specific value, and yet have a morphologic meaning of their own.

The extra molar of the Orang is probably a reversionary character, the extra ribs of the Auk and the little nodule occupying the place of the missing metatarsal certainly indicate an ancestral form with a longer body and four toes.

In the abnormal sacrum of the *Menopoma* and the five pairs of ribs of the Cat Bird we have progressive variations, and these are of much rarer occurrance than retrogressive characters.

The parapophyses in the sacral vertebræ of Cormorants are teleological modifications, efforts to provide an additional brace for the pelvic walls of these strong swimmers.

The differences in the axial skeleton of birds and Amphibians indicate that variation in this region is not greatest in animals now possessing the largest number of vertebral segments, but in those whose embryology hints at the existence of more vertebræ in their comparatively immediate ancestors than are possessed by the descendants of these forms.

This would account for the frequent appearance of extra ribs in birds, the inconstancy of the number of vertebral segments in Urodele Amphibians, and the constancy in the vertebral column of mammals.

To conclude, many variations are reversionary in character, some progressive, and some due to physiological causes, most, if not all, have some definite meaning in their abnormality.

NOTES ON JAPANESE METEOROLOGY.

BY ALBERT S. ASHMEAD, M.D., NEW YORK, N.Y.

DESPITE the humid climate of Japan, rheumatism is very rare among the natives, which is probably due to the practice of daily hot bathing.

The meteorology of Japan is exceedingly peculiar and of exceptional interest. As particular influences in the process of acclimatization may be mentioned, lessened, eliminatory activity of the lungs, increased activity of the skin, diminished cardial circulatory power. A prolonged residence in the Japanese climate is productive of general physical relaxation, with increased susceptibility to cold. After a two years' residence in Japan, Europeans feel the necessity of wearing more substantial winter clothing, as the climate seems to have become harsher since the beginning of their sojourn. Any foreigner who permanently resides there and wishes to feel at ease must resort to the hot bathing of the natives; being in Japan, he must do as Japanese do. Europeans, on their first arrival, are very prone to rheumatism, and even perfected acclimatization does not do away with that propensity. The hot-bath habit is singularly favorable to perfect acclimatization; it, and also the customary and frequent hot tea, mitigates the depressive influence of the summer kakké months, the wet season of June, July, and August. Strange to say, in their national disease, beriberi, there is an entire absence of perspiration; these patients perspire only in their last agony. One should think, after that, that the Japanese would consider baths as remedial in kakké. Strange to say, it is not so; they consider it only as an essential and, for them, very pleasant part of the toilet.

In kakké the popular verdict is, and has always been, that it is detrimental. The altitudinal is their most efficient treatment. Such a treatment is always, at least in our European and American experience, a dry one; dry air. It is not so in Japan; in their mountains, even as high as 3,000 feet above the sea level, you will find an increase of humidity, due to the precipitation from the volcanic peaks. Even in this heavy humidity, where they are endeavoring to cure a disease in which perspiration is suppressed, they do not give to the hot baths which are used there as much, but not more than in other not sanitary places, credit for any good accruing to the patients. And, in fact, if hot bathing contributed to the cure, such an influence would be observed at the sea-level as well as in high altitudes.

Of course, I cannot treat the question expressed here. Let me only say that, in my opinion, humidity has nothing to do, directly at least, with beriberi; it is not a climatic rheumatism. Its cause is the action of a carbonic poison in the blood, and that poison cannot be eliminated through the influence of hot water. Hot bathing, as I said, has nothing to do with it, either directly or indirectly. Indirectly humidity has, because it keeps the carbonic gases together and prevents their dispersion. The oxydizing influence of the pure air of the mountain heights has everything to do with the cure.

LETTERS TO THE EDITOR.

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

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

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

Bibliographic Work in Vegetable Physiology.

I AM on the point of making a suggestion to students of botany, chemistry, and more specially of physiology. I would be glad to receive notes concerning the literature of *any* question in physiology, in order to use them in my bibliographical work concerning the physiology of plants. Under the head-title of "Contributions from the Missouri Botanical Garden" a series of bibliographical papers will be published, treating of every question within the range of vegetable physiology.

Students of any college in the country could assist me a great deal, if they would inform me of their being willing to pick up occasional notes on this or that question. The bibliographies of *Inuline*, and of the *Tannoids*, both with special reference to the rôle played by these constituents in vegetable physiology, have already been issued. The question taken up at present is that of the *alcoholic fermentation.* Anybody wishing to assist the writer in preparing his bibliography on this subject by sending lists of references — all of which will be welcome — or by looking through a journal or other periodical, thus saving a little time for the writer, without much loss of time for himself, will receive hearty thanks, and will be mentioned as a contributor.

This note being submitted to the attention of *all students* of science as well as professional scientific men, I wish that students of colleges and universities would act upon it. Often students are at a loss as to how to do scientific work and contribute to general knowledge. Here is one of the departments where much work is needed. References might be taken in the following way:

1. Select some chemical, botanical, or physiological journal. Begin with Vol. I., and go over the whole series carefully, noticing every place where the alcoholic fermentation has in any way been mentioned.

2. Write carefully: (*a*) Title of the paper, (*b*) name of the journal (for journals, see Bolton's Catalogue of Scientific and Technical Periodicals, 1665–1882, and his Catalogue of Chemical Periodicals, the first is found in any library, and was published by the Smithsonian Institution; the latter is found in the annals of the New York Academy of Sciences, Vol. III., Nos. 6–7, pp. 161–216, 1885, with supplement, ibidem, Vol. IV., pp. 19–22, 1887), (*c*) volume, page, and year.

3. Examine text-books and handbooks in which the question of the alcoholic fermentation is mentioned.

4. Examine also papers and works which do not bear directly upon this matter; sometimes interesting remarks may be found.

J. CHRISTIAN BAY.

Missouri Bot. Garden, St. Louis, Mo., July 18, 1893

A Plea for Botany in the Small Colleges.

The many pleas made for a better presentation of botany in the larger institutions of the country, have induced me to add a word for botany in the smaller colleges.

The present status of the science in these institutions is indeed discouraging as it is presented in their catalogues. The traditional term of botany given by an instructor in physics or chemistry is the common allowance doled out to the students. The conditions are, however, changing gradually, and chairs of biology are being established in many of the smaller colleges, whose incumbents are occasionally botanists. As a teacher of botany in one of these colleges, the writer wishes to add a plea for the introduction of botany in its proper proportion into the college curriculum.

The character of the work of the college is somewhat different from that of the university in that its courses are necessarily briefer and less specialized. Their students more frequently pursue a course which leads to the so-called general education, and the question naturally arises, what place has botany in such a scheme of equipment for life?

To the average college graduate few if any of the sciences can be said to be directly useful, they profit him largely in the breadth of view which they give, and the pleasure they are able to furnish in their contemplation or pursuit. In these latter respects one can scarcely conceive of a science which would rank higher than botany. There are certainly no phenomena which are met with more frequently by the non-professional than those which appertain to plants and plant life. Without becoming sentimental one may say with truth that to one who has an intimate knowledge of this field of nature the world around us takes on a new aspect, and new truths can be discovered and added daily to the fund already acquired. But it is on account of the peculiar adaptability of botany to teaching, that the science should appeal to the smaller institutions.

That science is best adapted to teaching which is able to present its material at first hand for investigation, and whose truths are within the ability of the student to discover.

The material for botanical study is abundant everywhere, and presents problems in a measure peculiar to each region. The early stages of investigation in the science are not difficult and do not require expensive apparatus. The live teacher who sends his students to the field and not to books, will find in botany a science in which enthusiasm can be aroused and progress made without an expensive outfit.

In the planning of our college courses in botany one must needs bear in mind two classes of students, those who are to go on with the science and those who pursue it as one of the elements of a general education. It is the former class who too frequently suffer in the average college.

The courses should be given in such a manner as to give the student who wishes to pursue the science in a university a foundation which does not need repeating because it is antiquated or abbreviated. In this way I believe the small colleges can be made centres of enthusiasm for botanical science, which will materially advance its teaching and its standing in this country.

It is to be hoped that botany will one day take its place in the curriculum of the small college as one of its most important constituents for the training of men.

X.

AMONG THE PUBLISHERS.

"CAMP-FIRES of a Naturalist" is the title of a forthcoming book which sketches big-game hunting in the west from a fresh point of view. The author describes the actual adventures and experiences of a naturalist, Professor Dyche, of Kansas University, who has hunted from Mexico to the northern confines of British Columbia, pursuing grizzly bears, mountain sheep, elk, moose and other rare game. As an outdoor book of camping and hunting this possesses a timely interest, but it also has the merit of scientific exactness in the descriptions of the habits, peculiarities and haunts of wild animals. The author is Mr. Clarence E. Edwards, and the book is to be published immediately by D. Appleton & Co., with many illustrations.

—Professor Charles S. Minot's "Human Embryology" is announced to be translated into German. The translation is being made by Dr. S. Kæstner and will be published by Messrs. Veit of Leipzig. The author has revised the entire work for the German edition and has made a series of changes and additions, which will render the translation practically a new edition. Among the changes is the making of a new chapter in the Introduction, giving a complete account of the external development and growth of the human embryo through all stages. References have also been added to important papers published since the original American edition was issued. The honor of a German translation has hitherto been accorded very rarely to American scientific works.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

A complete set of Bulletins of U. S. Geological Survey, various reports and bulletins of surveys of Missouri, Arkansas, Minnesota, Alabama, Illinois, New York, Pennsylvania, Indiana, Ohio and Texas; iron ores of Minnesota; Wailes' Agriculture and Geology of Mississippi (rare). To exchange for periodicals and books on Entomology or for Lepidoptera. Rev. John Davis, the Deanery, Little Rock, Ark.

For sale or exchange.—A complete set of the report of the last Geological Survey of Wisconsin, T. C. Chamberlin, geologist. It consists of four large volumes, finely illustrated, and upwards of forty large maps and charts. Will sell for cash or exchange for a microscope. Address Geo. Beck, Platteville, Wis.

For sale or exchange for copper coins or rare postage stamps. Tryon's American Marine Conchology, containing hand colored figures of all the shells of the Atlantic coast of the United States. Presentation copy, autograph, etc. One vol., half morocco, 8vo, usual price, $25, postpaid, $15. Botany of the Fortieth Parallel of the Hundredth Meridian of the Pacific R. R. Survey. Other Botanical works and works on Ethnology. F. A. Hassler, M.D., Santa Ana, Cal.

I have a fire-proof safe, weight 1,150 pounds, which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

For exchange.—Hudson River fossils in good condition from the vicinity of Moore's Hill, Ind., also land and fresh water shells. Desire fossils and shells from other groups and localities. Address Geo. C. Hubbard, Moore's Hill, Ind.

For sale at low price.—A fine old-fashioned photographic camera, rosewood box, one foot square, lenses, four inches diameter, made by C. C. Harrison. Plateholders, troughs, baths, etc., all in large wooden case, formerly the property of the late President Moore, of Columbia College. This is a fine example of an instrument of the best make for the old wet-process methods, and valuable to any institution or amateur interested in the history of photography in the U. S. Address M. S. Daniel, 236 W. 4th St., New York.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

Wants.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

DRAFTSMEN WANTED.—The Civil Service Commission will hold examinations on August 15 to fill two vacancies in the War Department; one in the position of architectural draftsman, salary $1,400, the other in the position of assistant draftsman, Quartermaster General's office, salary $1,200. The subjects of the architectural draftsman examination are letter-writing, designing specifications and mensuration, and knowledge of materials; of the assistant draftsman examination they are letter-writing, tracing, topographic drawing and projections. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

A YOUNG man who has been through the course in mathematics in Princeton University, wishes some tutoring this summer. Rates reasonable. Address P. H. Westcott, Cramer's Hill, Camden Co., N. J.

A GRADUATE of an American Polytechnic institution and of a German university (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry, Address Chemist, 757 Cary St., Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

THREE teachers wanted for a male and female seminary in central New York. Typewriting, etc., languages, mathematics, sciences, *et. al.* Send stamp with and for particulars. Box 701, Hempstead, L. I.

SCIENCE

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SCIENCE

NEW YORK, AUGUST 4, 1893.

THE FLORIDA LAND TORTOISE-GOPHER, GOPHERUS POLYPHEMUS.

BY HENRY G. HUBBARD, DETROIT, MICH.

IT seems very strange that so little has been known, or at least has been published about the habits of this very common animal. Winter visitors to Florida and the Gulf States often observe their burrows on the sandy ridges, each with its yawning entrance and scattered mound of subsoil, and are not unlikely to mistake them for the woodchuck holes with which they are familiar at the north. It is the permanent resident, however, that is most likely to have some acquaintance with the animal itself; for only in the hottest weather and at noonday does the gopher leave its burrow to feed upon the surrounding grass and herbage.

In summer, when the thermometer is in the nineties, the animal comes forth daily, some time between the hours of eleven A.M. and two P.M., and takes a careful look around to assure itself that no danger threatens. Then, if no ominous sounds disturb the stillness of the sultry air, it raises itself high on its ungainly legs and starts briskly off for the nearest patch of grass or cultivated field.

For about an hour the gopher wanders about with its long neck outstretched and plucks ravenously at every green vegetable within its reach. Often, indeed, in its eagerness it cracks up and swallows dead twigs and dry leaves together with the more succulent food, until its ravenous appetite is appeased. It then retires to the bottom of its burrow in the moist, cool sand, there to remain until the morrow or, if the season be rainy, until the next dry, hot day.

The gopher is a very timid and alert animal, and although it feeds with great gusto and apparent abandon, it is seldom so absorbed in its work that it fails to hear the sound of approaching footsteps. The near approach of any large amimal sends it scurrying back to its hole. It requires lively work to head off its retreat, but if surprised and captured at a distance from its hole, like other turtles, it retires into its shell, and, drawing its plethoric and scaly fore paws like double doors over the front of its shell, it resigns itself supinely to its fate, and never under any circumstances attempts to bite or otherwise defend itself.

In winter the gopher very rarely quits its burrow, and comes forth to feed only on the very hottest days at noon. In the warm Florida soil it is never torpid, but remains quiescent at the end of its gallery awaiting the return of dog-day weather.

A well grown gopher measures 10 inches in length by $7\frac{1}{2}$ inches in width and $4\frac{1}{2}$ inches in thickness, and weighs about 6 pounds. Individuals are sometimes found measuring $12 \times 9\frac{1}{4} \times 5$ inches, and weighing 9 or 10 pounds.

They are sold in the markets of many towns at high prices, and are eaten by the negroes and lower classes everywhere in the south. The flesh is excellent in quality, very tender, of a rich red color and has the appearance, flavor and odor of beef. But the supply of meat obtainable even from individuals of the largest size is scanty, the greater part of the body cavity being occupied by the enormous gut crammed with grass and the long intestines filled with wads of fibrous dung. The flesh is greatly relished by all carnivorous animals, but a gopher of average size has little to fear from their attacks. The largest dogs are unable to bring their canine teeth to bear upon any vulnerable part unless the specimen is young and small enough to be taken into their mouths.

In May or June the female deposits in the sand outside of her burrow from one dozen to twenty eggs. The eggs are perfectly spherical, pure white in color and have a diameter of $1\frac{5}{8}$ inches. More beautiful objects can hardly be found to grace an oölogical cabinet.

The burrows of the gopher are excavated by the aid of a remarkable spade-shaped projection on the front of the under shell, assisted by the powerful fossorial front legs, which are armed for this purpose with strong blunt claws.

In the sandy uplands of Florida the galleries descend at an angle of about 35°, and reach a vertical depth of seven to nine feet from the surface of the ground. They follow a straight course unless deflected by a root or some other obstruction and usually terminate in a layer of indurated soil. The length of the gallery varies from twelve to eighteen feet. The temperature at the lower end does not vary greatly throughout the year, and will generally not fall below 74° in winter nor rise above 79° in summer. The conditions as to moisture are probably equally constant. At Crescent City, Fla., where these observations were made, the permanent water table lies at an average depth of eighteen feet. The burrow of a gopher once completed becomes its permanent residence, and it is with extreme difficulty that the animal can be compelled to vacate and excavate a new home.

It is inhabited by the same individual for long periods of time, and if the popular belief in the great age attained by turtles in general and the land tortoise in particular is well founded, some of these reptilian domiciles may have antedated the present century, and even rival in antiquity the dwellings of man. Certain burrows in this vicinity are pointed out as having been in existence twenty-four years ago, when the oldest orange groves were planted. This necessarily implies a continuous occupancy by the same individual tortoise during that period, since if the galleries are abandoned they shortly become filled up and obliterated in our shifting sand.

Every naturalist will appreciate under the above showing what unusually favorable conditions here exist for the preservation of animal life, and will not be surprised to learn that these little sand caves, with their equable climate, permanent and abundant moisture, perpetually and hospitably open to the outer air, afford an asylum and a domicile to a most interesting assemblage of animals. The list of these, when it shall have been completed, bids fair to become a long one.

Not only the Florida burrowing owl, the rattlesnake, the rabbit, the raccoon and the opossum find in them a temporary shelter, but another vertebrate also, a frog, here takes up its permanent abode and lives on terms of perfect friendship with the gopher. This frog is the sub-species *Rana areolata æsopus*, a beautiful form, with soft subterranean coloration and crepuscular, toad-like habits.[1]

It is not at all rare, nearly every gopher hole harbors one or several specimens. They may be seen at evening sitting just outside the entrance of the burrow, and frequently in the morning or on cloudy days their softly radiant eyes may be detected gleaming out of the shadows a few feet back from the entrance. It is not easy to capture them, except with a baited hook and line, for at the slightest alarm they leap quickly down the yawning throat of the gallery and disappear from view. Specimens of this frog have been seen which would weigh more than a pound, and individuals of colossal proportions are reported to exist.

In January and during July of the present year more than a dozen species of articulates have been discovered living in the gopher holes. The majority are undescribed and new to science.

[1] Mr. Fred'k C. Test, of the National Museum, who kindly determined the species, writes: "Only one specimen, the type, is in the museum collection or presumably in any other." The type specimen came from Micanopy, Fla., probably without notes of habits, etc.

Two only are parasitic upon the gopher: (1) a large tick, which fastens itself upon the skin of the animal or to the sutures of the shell; (2) a gigantic acarus, a quarter of an inch in length, which does not remain upon the body of the gopher but attacks it within the nest, which, like the bed-bug, it never quits. Some of the burrows are infested with these blood-sucking mites and others appear to be entirely free from them.

The dung of the gopher furnishes food to five beetles and one interesting caterpillar of a moth. All of these are new and peculiar forms, presenting characters that indicate subterranean habits of life. A large wingless cave cricket, apparently a *Phalangopsis*, swarms in all the burrows.

Three predatory beetles, one of which, a new species of *Anthicus*, may prove to be a prowler from without, have been found within the galleries.

A very large specimen of the whip-tail scorpion (*Telephonus*) was found in one of the burrows. It was living in a short gallery of its own, which opened into the nest of the gopher at the lowest level. A minute *Pseudo-scorpion* is also found at the lower end of some of the burrows.

A flea of undetermined species, of which a single specimen was found in one of the holes, may prove to be an intruder, left behind possibly by some mammalian visitor.

The following is a review of the animal parasites and messmates of the gopher:

Vertebrate.

1. The gopher frog, *Rana areolata œsopus*.

Articulates.

1. *Copris*, new sp. Feeding upon dung of gopher.
2. *Onthophagus*, sp. Feeding upon dung of gopher.
3. *Saprinus*, new sp. Feeding upon dung of gopher.
4. *Saprinus*, sp. Feeding upon dung of gopher.
5. *Aphodius*, new sp. Feeding upon dung of gopher.
6. *Staphylinide*, probably a Philonthus. Predatory.
7. *Trichopteryx*, sp. A species found also outside.
8. *Anthicus*, new sp. One specimen only.
9. Pyralid moth. Caterpillars feeding upon dung.
10. Cave cricket (undetermined).
11. Acaride parasite of the gopher (undetermined).
12. Gopher tick (undetermined).
13. Pseudo-scorpion (undetermined).
14. Whip-tail scorpion. Predatory intruder.
15. Flea, probably a mammalian parasite.

Most of the insects have been submitted to Mr. E. A. Schwarz, of the Department of Agriculture, Washington, D. C., and to him I am indebted for the determinations given above.

NEW METHODS OF TREATING THE SICK.

BY WILLIAM C. KRAUSS, M.D., BUFFALO, N.Y.

ON June 1, 1889, Professor Brown-Séquard presented a communication to the Société de Biologie of Paris on a new method of therapeutics. It seems that Brown-Séquard had been at work on this project for many years, for, in 1869, he expressed a belief that if it were possible to inject spermatic fluid into the veins of old men they would experience a rejuvenation, sexually, mentally, and physically. After repeated experiments upon rabbits, dogs, and guinea-pigs, he, in a true scientific spirit, injected some of the testicular fluid into his system, and his experiences and results form the most interesting part of his memorable communication to this learned society. "The author of this communication, now 72 years old, has for the past twelve years watched his physical powers slowly and continually decline. The laboratory work has become laborious and heavy, and after each meal I have been obliged to take a short nap. After the third injection a complete change took place. The work in the laboratory has become agreeable, not the least fatiguing, and after three and a half hours of such work I have been able to edit a memoir. The dynamometer showed an increase of 6.7 kilogrammes, the bowels regained their former activity, and, in short, I have regained all that I have lost."

These results, coming from one of the ablest physiologists in France, yea, of the world, were in an incredibly short space of time dispatched to all corners of the earth, and Brown-Séquard's "Elixir of Life," erroneously called, was being tested by hundreds of doctors and would-be scientists.

Enthusiastic reports are not easy to corroborate, and the Elixir of Life was doomed to bitter disappointment. At first encouraging results were reported by a class of observers least fitted to test the virtues of the new discovery, but in a short time the whole proceedings were looked upon with disdain and distrust.

Not so in France, Brown-Séquard published several later reports with equally good results, and the experiments were further conducted by some of his co-workers and students. The hypodermic injections of testicular juice gave encouraging results in anæmia, organic diseases of the brain and spinal cord, cachexia, tuberculosis, and in many of the chronic diseases. It was also found that *ovarian juice* gave nearly the same results as did the testicular juice.

Thyroid juice. It has been definitely proven that removal of the thyroid glands from a dog will be followed by death. Gley, in his experiments, decided to inject the juice of thyroid glands in dogs thus deprived of these glands, and, instead of dying, they recovered without any serious difficulties. In the human family it has been found that after removal of the thyroid gland or the destruction of this gland through disease, that a certain train of symptoms will develop, which had received the name of myxœdema, a disease characterized by swelling of the face, body, and extremities, loss of hair, sub-normal temperature, etc. Horsley attempted to transplant the thyroid gland of animals to these patients, and met with partial success. Dr. Murray of Newcastle, England, then injected hypodermically a glycerine extract of thyroid gland into patients suffering with myxœdema, and his efforts were rewarded with beneficial results. Brown-Séquard and D'Arsonval were conducting similar experiments about the same time with equally good success. It was found, however, that the injection of this substance was followed in many cases with pain, inflammation, and abscess formation. To overcome these hindrances, Fox of Plymouth and Mackenzie advised and practised the treatment of myxœdema by feeding with sheeps' thyroid glands, and the results seemed to be in every way satisfactory.

The writer has had a little experience in treating two cases of myxœdema, but he has been unable to attain anything like the results claimed by the English and French writers. In fact his experience has been negative, not even obtaining temporary improvement.

MacAlister of England has treated cases of pseudo-hypertrophic paralysis with injections of thymus gland extract; also a case of lymphadenoma with a mixture of red and yellow marrow, with seemingly good results.

Dieulafory of Paris has injected extracts of the cortical portion of the kidney into patients suffering with Bright's disease. He proposes the name Nephrine for this particular fluid

Comby and Dieulafory have also injected the extract of pancreas in cases of diabetes, with temporary good results.

Spermine is the name of another fluid extract derived from Brown-Séquard's testicular juice, its action seems to be similar to the testicular juice, acting upon the motor areas of the cerebrospinal axis, increasing the strength of the arms and legs, regulating the sexual, urinary, and digestive functions, and in improvement of the general sensibility.

American experimenters have not been idle during the rise of this *fin de siècle* therapeutics. There are now houses in New York manufacturing animal extracts known as cerebrine, medulline, testiculine, musculine, and other newly-coined-word remedies which have been recommended in the various diseases of the human body. Personally, the writer has had experience with cerebrine only, and, if he has noticed any results, they have been but temporary. Perhaps they do not even deserve the name "result," only a reaction had set in. Those of the writer's friends who have had experience with these remedies have also obtained negative results. The injection of water and glycerine has succeeded in accomplishing exactly what the animal extracts have done.

What the outcome of this innovation will be, or where it will end, is at present impossible to say. The field is so broad and the inclination to experiment so great that, in all probability, some little time will elapse before the returns will all be in. Whether these extracts exert any specific action, or whether the results thus obtained have been through "suggestion" and auto-suggestion, is likewise hard to explain, the writer is inclined to the latter view, that "suggestion" has been the "specific" agent.

NOTES ON ARSENIC.

BY JAS. LEWIS HOWE, POLYTECHNIC SOCIETY, LOUISVILLE, KY.

NOTWITHSTANDING the well recognized danger of arsenical greens as coloring materials, their use is still far too common, especially in green enameled papers for covering boxes and for more reprehensible purposes. I cite two cases in point.

1. Some time since my attention was called to some so-called "Kiss Candies" for sale in a little variety shop, largely patronized by the children of a neighboring public school. These candies were squares of caramel, etc., each wrapped up with a verse of poetry (?) in a piece of colored paper, together with other candies not wrapped. Some of these papers were colored with anilin dyes, but a very considerable number were green enameled papers. An examination of several of these latter revealed the following:—

Paper I. Bright-green surface, 50 square centimetres, arsenic found (estimated as arsenious oxid), 0.0285 of a gram.

Paper II. Light-green surface, 50 square centimetres, arsenic found, 0.0062 of a gram.

Paper III. Dark-green surface, 50 square centimetres, arsenic found, 0 0093 of a gram.

Paper IV. Bluish-green surface, 47 square centimetres, arsenic found, 0.0209 of a gram.

In the latter cases the enameled surfaces appeared much abraded, doubtless by contact with the other candies.

It is needless to say that here was not only a grave danger of the surfaces of the candies containing considerable arsenic, but the well-known habit of young children of putting everything bright colored in the mouth, might have easily resulted in taking a toxic dose.

2. Very recently there has appeared in the market a natural leaf twist chewing tobacco, wrapped around with a strip of green enameled paper three-fourths of an inch wide and about six inches long, fastened to the tobacco by a tack. The surface of this paper is an arsenic green. An examination was made of the twist by cutting off the exterior and using Reinsche's test. Distinct traces of arsenic were found. The quantity from a single twist was far too small to be dangerous, but it is needless to say that the practice of using arsenic paper under such circumstances should be condemned, and the manufacturers of the twist were cautioned on the point. The arsenic found in the tobacco doubtless came, by abrasion, from the paper wrapped around it, but there is another possibility. It is more or less widely known that Paris-green is used by tobacco-growers against the tobacco worm. While in general, when properly used, probably no danger is to be apprehended, it has occurred in my knowledge that tobacco has been sprayed very shortly before gathering. This would seem to be dangerous, and investigations upon this point are being now carried out.

As regards the detection of arsenic in medico-legal cases, attention has been called by Dr. Bernard Dyer in the Proceedings of the Chemical Society[1] to the fact that in certain cases, at least, a large proportion of the arsenic is precipitated upon the zinc in Marsh's test. The following is an observation in point. Arsenic was recovered in a certain case by Reinsche's test on six pieces of copper foil, each 20 square centimetres surface. Three of the pieces were divided, and from each the arsenic was sublimed in well-defined crystals, which could be identified without difficulty. From the other three pieces all the arsenic was sublimed, dissolved, and submitted to Marsh's test. Only the very slightest trace of a mirror was found, not enough to identify it as arsenic in a doubtful case. In this case, as in that of Dr. Dyer, cast zinc was used.

[1] Proc. Chem. Soc., 1893, p. 120.

Another recent case illustrates the necessity of the physicians who perform the autopsy preserving other organs than the stomach. G. had given her husband coffee from a pot in which she had emptied probably a whole box of Rough on Rats. He drank two cups, containing probably in the neighborhood of 7 grams. The coffee left, which I afterwards examined, was practically a saturated solution of arsenious oxid. Death ensued in four hours. The stomach was brought me, and was found to be empty, and much inflamed. Using the whole stomach, but a very small quantity of arsenic was found, evidently only what the walls of the stomach as a tissue could absorb, and far from enough to have produced death. The corroborative testimony was, however, sufficient to secure the woman's conviction.

Brodie's statement that when arsenic is taken in solution no trace of it will be found in the stomach is too broad, but it is imperative that in such cases other organs, notably the liver (as well as spleen and kidneys), should be preserved for analysis.

In my own experience, Reinsche's test, when carefully carried out, is far more satisfactory and no less certain in testing for the presence of arsenic than Marsh's. It can be readily learned by medical students and used practically by the physician, which is not true of Marsh's test. In order to secure well-defined arsenic crystals in Reinsche's test with a minimum of arsenic, I have found it desirable to use electrolytic foil, to roll the strip very closely, and to sublime in a tube of the smallest possible diameter.

A NEW IDEA IN MICROSCOPE CONSTRUCTION.

BY C. W. WOODWORTH, UNIVERSITY OF CALIFORNIA, BERKELEY, CAL.

EVERYONE who has worked with the microscope, especially in studying rather large objects with medium and low powers, has felt the need of a better means of orientation than those at present available.

Stage forceps admit of complete rotation in one direction and some degree of motion at right-angles to this by raising or lowering the object and readjusting the focus. Ordinarily, any change in the direction of the object requires this readjustment of the focus, and generally the part to be studied is out of the field and must be found as well.

The ideal condition would be to rotate the object at the exact focal point of the microscope, and one can readily see that this could be attained if the object was supported by an apparatus revolving upon two axes at right-angles to each other, which intersect at the focal point, provided neither of these remains fixidly coincident with the optical axis.

There are many ways by which this condition might be attained, but perhaps as simple a modification of an existing stand as could be made with this object in view is a stand I have recently had the Bausch & Lomb Optical Company make for the Entomological Department of the University of California.

The instrument is a "Model" stand with an ordinary revolving mechanical stage. This is supported on a rotating bar, resembling the usual sub stage bar, and provided with a rack and pinion adjustment.

The stage is centred in the usual way, which brings the axis of revolution coincident with the optical axis. The stage bar swings upon a core which is adjustable laterally, so it becomes possible to make the axis of its rotation intersect the optical axis.

These adjustments being made, the instrument fulfils the conditions specified above whenever the focal point is brought to the axis of rotation of the stage bar. Consequently, in using the instrument the tube is brought to a certain position and the focusing of the object accomplished by means of the rack and pinion of the stage bar. The correct position of the tube is determined by trial for each objective, and marks made on the tube to indicate this position.

Different objectives, as those who have used revolving stages must have noticed, have somewhat different optical axes, and there is enough variation with the medium powers to make a centreing nose-piece essential.

While it is mechanically impossible to make all these adjustments perfectly correct, still I find that even with medium powers the object remains in the field during orientation, and that the fine adjustment is generally sufficient to keep it constantly in focus, and I have no doubt that it might be adjusted well enough to use satisfactorily as high a power as a long-focussed quarter-inch objective.

Indeed, the instrument has proven to be all that could have been expected of it as an orienting microscope, and, at the same time, its value for ordinary work is is no way decreased, unless the slightly less rigidity of the stage is an objection.

Plans have already been completed for a dissecting microscope for use in my laboratory embodying the same principal but involving greater changes from instruments now in use. The new stand will consist of a stage which remains horizontal, so that insects may be dissected on it under water. The arm is jointed and the lower section bent so that the axes of the two hinges are at right-angles to each other. There will be the necessary arrangements for so adjustlng these axes as to make them intersect, and the tube will be fitted with a nose-piece adjustment.

The base will be clamped to the desk for sake of rigidity. The focussing will be all done at the stage, though the tube will move to accommodate the varying focal-lengths of the objectives.

It is expected to use the objective under water, providing it with a hard-rubber shield having a cover-glass on the end. This kind of instrument should be also very useful for the study of aquatic forms.

SUMMER WORK IN MARINE ZOÖLOGY AT NEWPORT.

BY W. E. CASTLE.

OUT on the extreme southwestern point of the Island of Rhode Island, in Narragansett Bay, is Castle Hill, the comfortable residence of Mr. Alexander Agassiz. Against this point the waves of the Atlantic break with full force as they sweep round the east end of Long Island past Point Judith. This is the one rough spot in the trip from New York to Boston by boat.

As the tide comes in at Castle Hill and passes the narrow entrance of the bay, it makes a bend and carries its rich pelagic life into a little cove on the north side of the point. On this cove is Mr. Agassiz's laboratory.

It is a modest-looking little structure, modelled after a Swiss cottage, but within it is a very paradise for the marine zoölogist.

Aquaria, tanks, and glassware it contains in abundance, while fresh and salt water are carried in pipes to all parts of the laboratory. Fresh, salt water, and air to aërate the aquaria are pumped in by a wind-mill.

Mr. Agassiz carries on his own investigations in the smaller room at the west end of the building. The larger room of the ground floor each summer he generously puts at the disposal of a certain number of students from the Museum of Comparative Zoölogy at Cambridge, Mass.

Any day through the summer you may see half a dozen men here industriously bending over their microscopes, studying animals in their living form or preserving material for future study. On account of the extreme moisture of the atmosphere, little balsam mounting or clearing can be done at the sea-shore, so that work of this kind is usually postponed to be done at Cambridge during the fall and winter months.

Each morning at nine o'clock a hack from the boarding-house in town puts the men down at the laboratory door. It calls for them again at five, after their day's work is ended.

About ten o'clock each evening "Thomas," Mr. Agassiz's faithful man-of-all-work, rows slowly up and down the cove skimming the surface of the water with a tow-net. From time to time he lifts the net of fine cheese-cloth carefully from the water, turns it inside out and dips it repeatedly in a bucket of water.

The soup thus obtained is carried into the laboratory, diluted, and poured out into half a dozen glass dishes placed on black tiles.

Around these dishes the men gather upon their arrival in the morning, each furnished with pipettes and watch-glasses of various sizes. Every nook and corner of the dish is carefully scanned with naked eye and with the aid of lens, and in different lights, that no egg or larva, however minute, may escape notice.

After a man has acquired a general knowledge of the pelagic fauna, he usually confines his attentions to some particular group of animals, and the tow is sorted out and divided accordingly.

One man studies the mollusks, another the echinoderms, another the jelly-fishes, and so forth.

The tow is the chief source of material for study. It is supplemented, however, by dredging from the steam-launch, and shore collections at low tide.

The laboratory contains a good library of general works of reference, while literature on special topics is supplied from Mr. Agassiz's private library and from the museum library at Cambridge.

Not least among the advantages afforded to the training investigator are the helpful suggestions of Mr. Agassiz himself, whose long experience in marine work makes him an invaluable adviser.

With such excellent opportunities for advanced work in zoölogy, it is not surprising that in this little laboratory material has been gathered for many scientific papers of a high order, and that here many of the best zoölogists Harvard College has produced have received an important part of their professional training.

BACTERIOLOGY IN THE DAIRY.

BY C. C. GEORGESON, MANHATTAN, KANSAS.

THE bacteria which affect the quality of our dairy products may, for practical purposes, be classed under two heads, namely, those which are beneficial, and those which are injurious, and it is as essential to encourage the one as it is to wage a constant war upon the other. It has been established beyond a peradventure that the pleasant flavor and aroma of good butter are developed by certain species of bacteria present in the cream and instrumental in producing the changes which take place during the process of fermentation usually termed "souring." And it is equally well established that there are certain other species which, if permitted to get the mastery, will, as it were, overpower and neutralize the influences of the former class and give a disagreeable taste and smell to the butter. Both classes are present in all dairies, and the skill and success of the butter-maker depend in large degree on the recognition of this fact and his ability to foster the growth of the beneficial bacteria and to keep the injurious kinds in subjection. His chief weapon against the latter is cleanliness. Filth of every description is their best breeding-ground. But it also happens that the conditions are such, in surrroundings over which the butter-maker has no control, that, in spite of the strictest cleanliness on his part, the injurious organisms propagate too fast and deteriorate his products. Again, it may lie in the health, feed, or other conditions affecting the cows from which the milk is drawn. Under such conditions, what is he to do? It is the solving of this problem which has brought bacteriology into intimate connection with the dairy business; and the honor of solving it and thereby ensuring the production of "gilt-edge" butter under naturally adverse conditions belongs to the Danes.

In practical dairying there are two forms of physical means by which the growth of bacteria may be controlled, namely, cold and heat, relatively speaking. At a temperature at or near the freezing-point the active growth of the bacteria ceases, and hence the reason for keeping the milk cool by the use of ice. The cold produced by the ice does not kill the organisms or purify the milk, it simply retards their multiplication, and thus affords time for the dairy operations to take place before they work injurious changes. Heat, on the other hand, kills the bacteria. At the boiling-point nearly all those forms ordinarily found in milk are destroyed. But, as this high temperature affects the taste of the milk or cream by imparting the characteristic "boiled taste," in practice the temperature is raised to but 75° or 80° C., at which point the taste is not materially affected, and still the greater portion of the bacteria are killed.

This much known, the Danes have gone a step farther. They have isolated and perpetuated "pure cultures" of those forms which they have found to be beneficial to the production of first-class butter, and by impregnating the cream, under proper conditions, with these artificially grown bacteria they give their butter the desired flavor and aroma. It is now between two and three years since the more advanced creamery owners began to practise this method, and the results have been so uniformly satisfactory that it is adopted in all creameries, when the ordinary methods fail to bring out the desired quality. The creamery owners were not slow to take advantage of this new discovery when they found that it afforded the butter-maker genuine and valuable practical aid. The honor of introducing this important improvement in dairy processes does not belong to any one man. Several scientists isolated and successfully prepared cultures for use independently of each other; though doubtless Professor V. Storch of the Experimental Laboratory, Copenhagen, deserves the lion's share of the credit. He has investigated the subject for some years, and published several important papers on the results of his researches. There are now three or four laboratories from which the prepared cultures are offered for sale to the dairies. They keep their processes secret, each following its own methods, the result of which is that their cultures differ, both in kinds of bacteria and method of treatment. This has brought out the fact that the beneficial species, as indeed also the injurious ones, are quite numerous, and that certain forms coöperate in the production of aroma and flavor, but that it is by no means necessary that a large variety should be present. Thus Mr. E. A. Quist of Skanderborg, Denmark, a young bacteriologist who has become deservedly famous for his successful work in this line, uses but two forms, which singly are ineffective, but together produce a very superior quality of butter.

The "secrets" in this work are, of course, far from impenetrable. They are confined chiefly to the composition of the nutritive fluid in which each laboratory has found it most expedient to propagate the bacteria employed, and this can, of course, be ascertained by experiment.

The value of "pure cultures" has been proven by practical experience. It remains to acquaint our dairy workers with the facts, and for our bacteriologists to take the work in hand. It offers a wide field for fruitful investigation.

INDIAN PAINTINGS IN SOUTHERN CALIFORNIA.

BY DAVID P. BARROWS, POMONA COLLEGE, CLAREMONT, CAL.

The Indian tribes which sixty years ago filled every valley of California have now either entirely disappeared or are represented by mere handfulls of descendants. These tribes left quantities of implements of their daily life to attest their vast numbers and certain remains through which can be traced their beliefs and customs.

An interesting study are their "picture rocks." These are found in many places throughout the coast and some of them have been examined and described.

In several localities in Southern California there are painted rocks to which, we believe, attention has not been called.

In the Perris valley, among the stony hills west of the town, are three rocks from twelve to twenty feet high which are covered, each on one side, with Indian paintings. There is evidence that this hillside at one time was the camping ground of a large number of Indians. About each spring the flat bowlders are filled with holes in which acorns and seeds were pounded, and pestles and *metates* are numerous. Bits of pottery, a portion of a grass basket and a few arrow points have also been found here. Twenty-five miles away on the opposite side of the San Jacinto plains there is now the small village Saboba, of the Serrano Indians.

On the Radec Creek thirty miles east of Temecula is an interesting case of rock painting. A hundred feet above the stream on the hillside there is a small cave formed by huge bowlders piled together. It is evident that the front of this cave was once walled up with brush, stones and earth and that it was used for a *temescal* or sweat house. The cold stream is at hand into which the patients, dripping with perspiration could plunge. The inside of this cave is painted with the same designs and colors as the Perris rocks. A flat rock inside is filled with holes in which it appears that the minerals for making the paints were ground. Digging down a few inches, into the loose soil of the floor, brought up broken pottery, charcoal and ashes, and bits of small bones. The interior of the cave is blackened with the smoke of the fires.

This cave is a quarter of a mile from the site of an abandoned village, which the Indians say was called Sequala. Relics, including a number of arrow points more perfect than are usually obtained in Southern California are here found. In the Strawberry valley in the San Jacinto Mountains there are four more of these painted rocks. The Cahvilla Indians still visit this valley for acorns and piñones.

Doubtless search and inquiry will reveal much more similar work. The designs, which in all cases are much the same, consist mainly of wavy and angular lines, diamonds, and geometrical patterns and figures formed by dots. The print of the open hand is occasionally seen.

There is little remarkable in these paintings unless it be the absense of *pictures*, and the fact that the same designs were adhered to not only by different tribes but by tribes of different stocks, showing that the established forms were wide spread and rigidly followed.

The colors used are red, black and white. They are made from mineral earths found in the mountains around, which are ground, mixed to the consistency of paste, and applied.

The most striking fact in regard to these paintings is this: Among the Cahvilla Indians whose home is in the San Jacinto Mountains, twenty miles from Radec Creek and eighteen from Strawberry valley in the opposite direction, there are two old men, and now only two, who at some feasts perform a remarkable war dance. The dancer is stripped to his breech clout and then girt with a kilt of beautiful brown eagle feathers, and his head is covered with a feathered war bonnet. His face and body are then painted with the same designs and colors which we have noticed. The same mud paints are used and sometimes the hand is daubed and its print struck upon the dancer's broad shoulders, precisely as it appears upon the Perris Rocks. Thus dressed and painted the old warrior proceeds to execute a dance which we venture to say is one of the most wonderful among the strange dances of the North American Indians; a dance which makes the old women shout and cry in excited remembrance, and infirm old braves wave their arms and join in the wild song.

There must be significance in these designs so carefully followed and preserved.

The writer and others are arranging for fuller examination of the rock paintings of Southern California with a view to publication. This note is intended simply to call attention to the double use of these designs upon the rocks and in the dance body-painting.

NOTES AND NEWS.

THE sixth annual meeting of the American Economic Association will be held in Chicago, September 11–15, 1893, in one of the assembly halls of the University of Chicago. It is expected that the general headquarters of the association will be at the university, which has not only permitted the use of one of its halls for the assembly to meet in, but also offers rooms in its dormitories at a moderate rent by the day or week to persons attending such conventions. Two meetings of the council of the association will be held during the session, and the programme as announced includes, besides the annual address by the President, Professor Charles F. Dunbar, the following papers: The Value of Money, by Francis A. Walker; The Relation between Interest and Profits, by Arthur T. Hadley; The Scope of Political Economy, by Simon N. Patten; The Genesis of Capital, by J. B. Clark; The Wages Fund at the Hands of the German Economists, by F. W. Taussig, and Marshall's Theory of Quasi-Rent, by E. R. A. Seligman. Several other societies dealing more or less with economic questions, including the International Statistical Institute, the American Statistical Society, the Social Science Congress and the Labor Congress, are to meet at Chicago at about the same time as the American Economic Association, and, as arrangements have been made to have the scientific sessions of these various societies held at different times, a rare opportunity is presented for the students of economic and social subjects to meet their co-laborers of this and other lands.

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

NOTES ON THE OCCURRENCE AND DISTRIBUTION OF UREDINEÆ.

BY M. A. CARLETON, KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN, KANSAS.

VERY little attention has been given to the distribution of parasitic fungi, except so far as to note their occurrence on host-plants of more or less close relationship, and that they are usually somewhat more abundant in wet seasons and places than in those that are dry. But close observation reveals more facts than these, and some that are peculiarly interesting.

Strictly speaking, the parasitic fungi are affected by but two of the elements of environment concerned in the distribution of phanerogams. These are *temperature* and *moisture*, while flowering plants are also affected by differences in kind of *soil* and amount of *light*

However, there is a kind of distribution of parasitic fungi, scarcely to be called geographical, although such distribution has probably been caused by changes in the anatomy and physiology of the host, which changes were themselves caused by variations in soil and climate. I refer to cases of certain hosts which support certain fungi in one locality and not in another. Of course, it may be said that in one or more of these localities there has yet been no chance for infection, but in numerous cases this is, to say the least, rather improbable, and sometimes the hosts are distributed so as to completely connect these localities, and yet without general distribution of the fungi. Moreover, some of these hosts are annuals, or occasionally biennials, so that it cannot be said that the fungi are prevented from spreading by the circumstance of their being reproduced yearly from perennial mycelium and not by infection by germinating spores.

Again, while a group of species (a genus, for instance) in one locality may all be attacked by a certain fungus, in another locality, where these hosts are all represented, only a part of the group may be affected by the same fungus.

Certain fungi have also peculiarities of occurrence in point of time. After being reproduced annually for several years, they may suddenly disappear for an indefinite period, or reappear after certain intervals of time.

In illustration of these general statements, it may be of interest to give here some observations that I have made on the distribution of Uredineæ in Kansas, covering a period of about six years.

In the first place, it seems to be true that *Aecidia* require more moisture than the other stages, and *telentospores* the least. In Kansas, east of the 96th meridian, the species of *Aecidia* number about fifty, and *telentospores* (of all genera) sixty-five; while west of the same meridian the proportion is about twenty-three of the former to fifty of the latter. The telentospores of western Kansas, it is seen, are more than twice the Aecidia. The difference in rainfall of the two portions is well known. But all Uredineæ are probably more abundant in wet seasons than in dry seasons, and also more abundant in warm seasons than in cool seasons. This season has been much earlier than the preceding one, and has been marked by a number of unusually hot days, alternating with heavy rains. Moreover, the rains have continued to date, and were quite frequent just at harvest time. The result has been a season unusually favorable for rusts. The following species have been collected in large quantities this season: *Aecidium peckii.*, De Toni, on *Oenothera biennis; Aecidium euphorbiæ*, Gmel.; *Aecidium violæ;* Schum., on *Viola falmota*, L., var. *cucullata*, Gr., and cultivated pansies; *Aecidium zanthoxyli*, Pk.; *Aecidium cepholanthi*, Pk.; *Puccinia graminis*, Pers. II.; *Uropyxis petalostemonis* (Farl.), De Toni; *Roestelia pirata*, Thaxt., on *Pirus coronaria; Uredo cœoma-nitens*, Schwein., on *Rubus villosus* (cult.) and *Rubus canadensis.* Immense numbers of spermogonia were found with *Aecidium peckii*, De Toni, and with the *Uropyxis, Roestelia*, and *Uredo cœoma-nitens*, Schw., above mentioned. *Puccinia graminis*, Pers., has been quite destructive to grains, especially oats, over the greater part of the State, but particularly in the eastern portion. It is a very interesting fact that, while this species was quite rare last year, it is the predominating rust of grains this year, and has caused extensive damage. Last year *Puccinia coronota*, Corela, was very abundant on oats, but this year, in repeated examinations, I have been unable to find a single specimen. Even *P. rubigo-vera* (D. C.), Wint., the ever-present grain-rust, is very scarce this season.

The greatest damage from rust prior to this season that I recall was in 1877, when there was a severe rust scourge over northern Kansas. Many fields of wheat were entirely destroyed, and never harvested. Sulphur-like clouds of spores filled the air and irritated the nostrils of the workmen. I had no knowledge of botany then, but a vivid remembrance of the general appearance of the rust, coupled with my present knowledge of the differences between the species, inclines me to believe that it was *Puccinia graminis*, Pers., that did the damage. I have always doubted the usual statements that *P. rubigo-vera* is the rust that usually does the damage in this country, and this season the facts in Kansas strongly confirm my opinion. Of course, the last-named rust is the more common from year to year, but seldom attacks the stem to any great extent, and, in my own experience, any amount of it on the leaves usually does little damage, but when the stem becomes covered with red powder and finally weakens and falls, and the grain shrivels, and the straw becomes very light, then you may guess that *Puccinia graminis* is in the field. However, there may be facts from other portions of the country, even this season, that furnish contrary evidence, for aught I know.

The above facts call up further instances of variations in the occurrence of species. The following species, originally known in Kansas, have not, to my knowledge, been reported for several years: *Aecidium abundans*, Pk.; *Aecidium cassiæ*, E. and K.; *Aecidium sambuci*, Schw.; *Puccinia similacis*, Schw.; and *Aecidium macrosporum*, Pk. During the succession of recent dry seasons they have probably become so reduced in numbers that finally there were not enough healthy spores left to reproduce the species on the following year. In like manner *Puccinia solida*, Schw.; *P. seymeriæ*, Burrill; *P. saniculæ*, Grev.; and *Aecidium punctatum*, Pers., seem to have disappeared. In future wet seasons infection may take place from a distance, and the fungi reappear.

As to migration, *Aecidium tuberculatum*, E. and K., has certainly been coming rapidly eastward, until this season it was found at Manhattan for the first time. *Uredo gaurina*, Pk., seems also to be coming eastward. *Puccinia heterospora*, B. and C., with its host (*Abutilon avicennæ*), *Puccinia xanthii*, Schw., var. *Ambrosiæ*, Burrill, several varieties of *Aecidium compositarum*, Mont., and *Puccinia microsperma*, B. and C., are, without much doubt, working westward. Others might be mentioned, but the possibility of their having been present for years already, and overlooked, forbids that we should place much dependence on such observations.

But a more remarkable phase of distribution is found in the fact that a number of species known on certain host-plants in western Kansas for a number of years are entirely absent in the eastern portion of the State from the same host plants, although the hosts themselves are very abundant in some cases. *Grindelia squarrosa*, Dund., ranges over the entire State in abundance, but *Puccinia grindeliæ*, Pk., has never, to my knowledge, been found east of Russell and Rooks Counties. Another singular fact is that I never found it on the variety *grandiflora*, Gr., which grows so abundantly in western Kansas. *Uredo gaurina*, Pk., and its *Aecidium*, too, are found in the western counties only, although three species of *Gaura* are native in eastern Kansas. *Lygodesmia juncea*, though not widely diffused in the eastern portion of the State, is still rather abundant in spots about Manhattan, but without any fungus; while over the western counties, not only is the plant itself very common, but it supports, in great abundance, a rust which has been named *Puccinia variolans*, Hark., var. *caulicola*, Ell. and Ev. I have noticed for several years that *Puccinia phragmitis* (Schum.), Korn., is never found on *Phragmites communis* in eastern Kansas (although abundant on *Spartina cynosuroides*), but is common on this host wherever found in the western counties, so *Uropyxis amorphæ* (Curt.), Schroet, abundant on both *Amorpha canescens* and *A. fruticosa* in the west, is found only on the former host in this region. What seems to be the *Puccinia grindeliæ*, Pk., above mentioned, is also found on *Aplopappus rubiginosus* in abundance in the west but this host does not grow in this region. In these cases may there not be anatomical differences in the hosts (of the same species, even) which cause this peculiar distribution of their parasites. At least, the question is worthy of close investigation. It is another indication, to me, that plant *pathology* cannot be well understood without a knowledge of plant *physiology*. I have already shown in another article[1] how the host-plants themselves vary in passing from the more fertile to the more barren districts of the great plains. The distribution of their parasites may be greatly influenced by these variations.

[1] "Contrib. U. S. Nat. Herb.," vol. XXI., No. 6, pp, 220–232.

IN MEMORIAM. — THE REV. W. C. LUKIS, M.A., F.S.A.

BY W. GREGSON, F.G.S., BALDERSBY, S.-O., YORKSHIRE, ENG.

The death of the Rev. William Collings Lukis removes a familiar figure from the ranks of British scientists, and one who will long be remembered with feelings of deepest respect and esteem, not only in Great Britain, where he lived and worked so long, but throughout the whole of the scientific world. His tall, erect, manly form, and genial countenance, were well known throughout Yorkshire, and he was certainly one whose friendship it was a pleasure and a delight to claim.

Mr. Lukis was not only an archæologist of world-wide eminence but was also a considerable authority on geology, botany and other branches of natural science. He had long been an observant traveller in various parts of Europe, Africa, America, etc. More especially in the Netherlands, Denmark, France, Italy, and Algeria; and his writings and researches show that accurate and intimate knowledge of those countries which he acquired from careful personal investigations. The deceased gentleman was also an artist of considerable power and merit, as many of his works, illustrated by his own hand, sufficiently testify. He was born on April 8th, 1817, in the Island of Guernsey (English Channel), and was the third son of Colonel Frederick Corben Lukis, by Elizabeth, youngest daughter of Mr. John Collings of Guernsey. From his father, who was also an archæologist of distinction, Mr. Lukis inherited a taste for natural science, which he pursued at the University of Cambridge, under Professors Henslow and Sedgwick, and the writer has frequently heard him dilate on the benefits he derived from his connection with such far-famed scientists. He received his early education in Guernsey, afterwards in France, and at Blackheath, near London, under the mastership of the Rev. Sanderson Tennant, whilst in January, 1840, he graduated in honors at Trinity College, Cambridge. Twelve months later he was ordained at Salisbury, by Bishop Denison, and licensed to the curacy of Bradford-on-Avon (of which parish the late famous Harvey, formerly private tutor to Prince George, now Duke of Cambridge, was then vicar). In 1845, he was appointed chaplain to the Marquis of Ailesbury, who successively presented to him the livings of Great Bedwyn, and Collingbowne Ducis in Wiltshire, and Wath, near Ripon, in Yorkshire; which latter he held for thirty-one years up till the time of his death. Whilst residing at Cambridge he was one of the earliest members of and contributors to the Camden Society, then newly formed, and when living at Bradford-on-Avon, he published a quarto volume on "Ancient Church Plate," also other works on "Church Bells," "Church Towers," etc.

In 1847 he was elected a Fellow of the Royal Society of Northern Antiquaries, Copenhagen; in 1853, a Fellow of the Society of Antiquaries, of London; and in 1867, a member of the Société Archéologique de Nantes, whilst in 1872, he was elected a corresponding member of the Société de Climatologie Algerienne. Mr. Lukis was the author of many works on barrows, and other prehistoric monuments, and was a practical barrow digger on an extensive scale, in various parts of England, France, Denmark, the Netherlands, and elsewhere. The Society of Antiquaries, London, published his scale plans of Rude Stone Monuments, with descriptive text. He also edited, for the Surtees Society, Dr. William Stukeley's Diaries and Letters, published in three volumes; and when the Ripon Millenary Festival was celebrated, in 1886, he was an active member of the committee, which was formed to carry out the arrangements, and wrote an interesting and valuable article entitled "Ancient Ripon," since included in Mr. W. Harrison's "Millenary Record" (a beautifully illustrated volume published at Ripon, in 1892).

Mr. Lukis, who was a prominent Free Mason, and a J.P. for Wiltshire, married Lucy Adelaide, daughter of Admiral Sir Thomas Fellowes, who survives her husband, and by whom he leaves two sons and four daughters; the eldest daughter being the wife of a son of the late Canon Hawkins, J.P., of Topcliffe, Yorks (a relative of Mr. Justice Hawkins), and the second daughter being the wife of Mr. H. C. Bickersteth (son of the late Bishop of Ripon, nephew of the Bishop of Exeter, and cousin of the Bishop of Japan).

A committee has recently been formed, under the chairmanship of Sir Reginald Graham, Bart., of Norton-Conyers, near Ripon (which is close to Wath, and where the talented authoress of "Jane Eyre" at one time resided), for the purpose of placing in Wath Parish church a strained-glass window, as a lasting memorial of the late much esteemed rector, who was so ripe a scholar, so kind a friend, and of whom it may be truly recorded: —

> He seemed the thing he was, and joined
> Each office of the social hour
> To noble manners, as the flower
> And native growth of noble mind.

OBSERVATIONS ON DUCKLINGS.

BY C. LLOYD MORGAN, BRISTOL, ENGLAND.

OF seven eggs transferred from a hen to my incubator only two hatched out. Of the others four had not been fertilized and the fifth contained a dead bird in about its tenth day of incubation. Several hours before the ducklings chipped the shell they were piping to be free. One (A) was hatched four hours before the other (B). They were left in the drawer of the incubator for about 20 to 24 hours, and were then transferred to an experimental poultry yard in my study. Somewhat unsteady upon their legs, they kept tilting backwards on to their tails; but A was decidedly the stronger of the two and his motor coördination was better. They pecked with uncertain aim at anything which caught their eyes, such as marks on the basket in which they were to sleep, grain, sand. Chopped-up white of egg was placed before them and moved about with a long pin to draw their attention to it. The coördination for pecking was far from perfect. When a piece was seized after several shots it was mumbled rapidly and then shaken out of the bill unswallowed. A shallow tin of water was placed before them. They took no heed of it. As they tottered about they walked through it several times, but no notice was taken. I dipped A's beak into the water. He drank with characteristic action; he then pecked at the water repeatedly and drank. Presently B imitated him, and he too drank repeatedly. Both pecked at white of egg held in forceps, seizing at about the third shot, but shook it out of the bill. Perhaps some was swallowed. I then put them to bed in their basket.

Two hours later they were taken out and waddled about with more accuracy of motor coördination. When they came to the water they both at once drank. They pecked at white of egg placed on a black tray to make it more conspicuous, but shook it out of their bills.

After another two hours A was dropped into a fairly deep bath. He floated and kicked vigorously, dropping excrement. In less than a minute he swam round and round the bath and pecked at marks on the side.

A little later both made for the tin of water and sat in it. They pecked with more accuracy and without suggestion (i. e., moving it about with pin) at white of egg on the tray, still shaking the head vigorously, but swallowing freely. A scratched his head two or three times, but tumbled over in the process.

Later in the evening of the same day they ate white of egg freely. The pecking coördination was much more accurate, but not quite accurate. I placed B in the bath. He kicked excitedly and dropped excrement; then swam about vigorously, pecking at the sides.

Next morning when taken from their basket both A and B made for the water in their tin and drank and sat in it. They ate keenly of white of egg, swallowing large morsels. Both scratched their heads occasionally, tumbling down. Both preened their down, rubbing their bills over their breasts. They applied their bills to the base of the tail and rubbed their heads along their backs in the most approved duck fashion. They stood up and clapped their downy winglets, toppling over backwards on to their tails from imperfect coördination.

In the middle of the day I placed a blue-bottle fly, from which the wings had been snipped off, near them. A followed, pecking at it, but failed to seize. It escaped under the newspaper which formed the floor of my yard. I routed it out. A again followed pecking, but the fly escaped through the wire netting. I placed it again in the yard. A followed and caught it at the third peck, swallowing it apparently with satisfaction. Put A in the basket. B then caught another fly after numerous abortive attempts.

Both A and B ate their own excrement and that of chicks, showing less signs of dislike than do chicks.

Tried the ducks with all sorts of odd things, bits of paper, chopped-up matches, leaves, flowers, small stones, red currants, anything of suitable size I could lay hands on. Each was seized and mumbled, and then either rejected or swallowed.

When three days old I threw to them the yellow and black-banded caterpillar of the cinnabar moth. Each seized it, but dropped it at once. Very soon no notice was taken of it. Next day on repeating the experiment A seized a caterpillar, but dropped it. B took no notice. They ate freely of green caterpillars from gooseberry bushes, and distinguished between these nice morsels and the nasty yellow and black caterpillars. They ate tadpoles placed in their water, noticing them directly they began to swim about.

I daily placed for them at about 9 A.M. in my experimental yard a large black tray with a shallow tin of water. To this they at once ran and drank, sitting in the water and washing. On the sixth day I put down the tray and tin as usual; but the tin was empty. They ran to it, went through all the action of mumbling the water and drinking. They sat in the empty tin wagging their little tails and ducking down their heads as if they were enjoying a good bath. They continued this procedure for about ten minutes. I then gave them some water. The next morning I repeated the same experiment, but though the ducks searched for water with their bills they did so with less vigor and zest.

A winged bee was thrown in. B seized it, but dropped it. A seized it, and after mumbling it for a moment, swallowed it. Possibly he was stung. He kept on scratching the base of his beak first on one side then on the other and seemed uneasy. But he was all right again in half an hour. There was no *instinctive* avoidance of bees. Subsequently he would not touch a bee. There was an *intelligent* avoidance of bees. Nor would they touch the bee-like fly, *Eristalis*. Its mimetic form served as a protective character.

Subsequently A seized a humblebee and after mumbling it in the water swallowed it and seemed none the worse.

The above jottings are extracted from my note-book and are given without comment. I may add that as compared with chicks the ducklings show less intelligence and develop psychically more slowly. Their greediness and vulgarity are painful to observe and to contemplate.

BACTERIA IN HEN'S EGGS.

BY MELVIN A. BRANNON, FORT WAYNE, IND.

THAT cider should turn to vinegar and milk become sour excites little wonder among common people or even individuals of considerable education. The mere statement of fact in such ordinary phenomena seems to satisfy the masses, but fortunately for scientific and sanitary interests, there is a class of individuals persistently questioning such phenomena till reasonable explanations are secured. Consequently the souring of cider and milk was found to be caused by the presence of organisms which produced acetic and lactic acids, respectively, whenever the proper medium was exposed in an atmosphere of moderate temperature.

Not only have these common but interesting phenomena, "souring" of cider and milk, been explained by the presence of bacteria, but many other phenomena, less common and more concealed, have been directly traced to the action of some form of bacteria associated with the matter in which the phenomena occurred.

Of course, no intelligent student holds bacteria responsible for every chemical change in organic matter, but it is well understood and universally admitted that the greater number of chemical changes in living and decaying organic material are induced by some bacterial form.

Recognizing the importance of recording every phenomenon relating to the presence and action of bacteria, it seemed proper to recite to readers of *Science* some of the details in a very peculiar case recently noted.

An acquaintance whose intelligence and acuteness of observation make his testimony thoroughly reliable, stated that one of his Plymouth Rock hens was laying eggs, every one of which had an unpleasant odor, although broken a few hours after it was laid. He also said that the hen was laying regularly and appeared healthy in every respect save that she had the gaps. A few days succeeding this statement he reported the fowl butchered and closely examined. In her craw was found a ball of threads pulled from manilla matting which she had access to. The ball entirely filled the craw and was very hard and compact, except in the central region, through which ran a cylindrical opening, affording a passage-way for the food. This ball of manilla threads and the craw gave the same offensive odor as did the eggs when broken. The heart, liver and digestive apparatus —excepting the craw—were normal in size and appearance.

A perfect egg was taken from the hen and personally examined. It looked and smelled like a perfectly fresh egg, but when broken it gave forth the same disgusting odor that had characterized her craw and previously laid eggs. This odor was exactly like that observed in decaying meat, and, had the broken egg been concealed, any person entering the laboratory would have suspected that decaying meat was exposed in that room.

The egg contents gave a strong alkaline reaction when tested with litmus paper. The general appearance of yolk and white was normal, but a portion of albumen mounted and carefully observed under the microscope, magnification 250 diameters, revealed the presence of a great number of bodies varying in shape from almost round to distinctly oblong. These forms closely resembled bacteria, but lack of time for tests and cultures made the determination of them impossible.

From these few observations and experiments it would be unscientific to definitely conclude that these eggs were decaying from the action of bacteria, but in view of the fact that the odor so closely simulated that of decaying flesh and that the egg contents were strongly alkaline, which would favor the development of bacteria, is it not exceedingly probable that this fowl had clogged her craw and set a great culture of bacteria developing there, till at length bacteria had gained admission to the oviduct through the blood and thus developed infected eggs?

This rather brief description in no wise pretends to explain this phenomenon. It has been given with a dual hope: First, that some bacteriologist whose experience has familiarized him with similar cases may give the desired explanation of how these bacteria, if they were bacteria, gained admission to these fresh eggs; second, that the attention of physicians and officers of boards of health may be attracted to this subject.

There is evidently as much necessity for caution in feeding hens as in feeding milk cows or in fattening beeves and swine. Chickens should not be fed all sorts of refuse matter and then be expected to return therefor good healthy eggs and meat. Yet we all know the universal practice in small cities and villages, where many of the market fowls and eggs are obtained, is to give over the office of scavenger to the feathered inhabitants. If the subject were properly regarded by physicians and the people were rightly educated, we might look for better things; till then the occurrence of such peculiar phenomena as the one related and even more unique, should not surprise scientific students.

A MALAY FIRE-SYRINGE.

BY F. W. RUDLER, MUSEUM OF GEOLOGY, LONDON, ENGLAND.

BY the kindness of my friend Mr. Henry Louis, the well-known mining engineer, who has recently returned to England from Singapore, I have received a fire-syringe which he obtained towards the end of 1890 from a part of the Malay Peninsula never previously visited by a white man. So far as I can ascertain, the use of the fire-syringe has not been hitherto recorded from this locality. Mr. Walter Hough, in his admirable description of the fire-producing appliances in the United States National Museum, published in the Smithsonian Reports for 1888 and 1890, refers to the syringes of Borneo and Burma, but makes no reference to those of the Malay Peninsula. No syringe from this locality is to be found in the very extensive ethnographical collections in the British Museum. Moreover, Mr. A. R. Wallace does not know of its use by the Malays, nor is it known to Professor Terrien de Lacouperie, who has lately written on the production of fire by the Chinese in his *Babylonian and Oriental Record.*

Mr. Louis obtained the specimen in question from a Malay who stopped with a party of others at his camp on a small stream known as Ayer Katiah, one of the tributaries of the River Teluban, on the southeast coast of the Malay Peninsula, and about 100 miles from the mouth of the river. The district is sparsely inhabited by Malays, and the party from whom the syringe was obtained had come from some of the neighboring Kampongs. They squatted down and began smoking, one of the men lighting his cigarette in the most matter-of-fact way by means of his fire-syringe. There is no reason to suppose that he was singular or had imported his apparatus from a distance. If the rest of the party elicited sparks by means of quartz and iron it was, they admitted, simply because they preferred this method as being less troublesome and more trustworthy than that of compressing air.

The Malay syringe consists of a tube of hard wood 2½ inches long, closed at one end, towards which the tube slightly tapers. It is surrounded with neatly plaited strips of thin rattan which, while they ornament the object, serve also to strengthen it and prevent the wood from splitting longitudinally in the direction of the fibre. The piston is made of similar wood and is packed with string. The tinder was carried in the hollowed-out skin of a large bean, like the seed of *Entada.*

In order to use the instrument a small piece of dry tinder is placed in the slightly hollow end of the piston and pressed down to keep it well in place; the piston is then inserted in the cylinder, smitten sharply with the palm of the hand and very rapidly withdrawn, when the tinder becomes sufficiently heated to slightly smoulder, and by then gently blowing it a bright glow may be obtained. According to Mr. Louis, the native never seemed to fail in his use of the syringe, but the knack is not easy to acquire, and those who have employed a similar apparatus for demonstration at physical lectures know that it is far from easy, even with a well-made instrument, to ensure success.

Contrary to what might have been expected, it was rather a young man who preferred this strange mode of producing fire to the more convenient flint-and-steel method. There can be no doubt that the use of the fire-syringe, never widely spread, is rapidly dying out, and hence every fact bearing on the geographical distribution of so curious a custom deserves to be put on record.

L'ORIGINE DES ARYENS.

PAR LE PROF. G. DE LAPOUGE, UNIVERSITÉ DE MONTPELLIER, FRANCE.

LES revues scientifiques et *Science* en particulier ont publié cette année une quantité d'articles qui avaient la prétention d'éclaircir la question aryenne, mais qui me paraissent avoir surtout produit le résultat inverse. Il me semble que l'obscurité vient surtout de ce qu'on ne s'entend pas sur la valeur de mots qui, détournés de leur signification primitive, sont maintenant bien près de n'en avoir aucune, tant elle devient vague. Partisan très actif de l'origine européenne et occidentale de la race blonde et de son identification avec les premiers auteurs de la culture aryenne, j'ai contribué sans le vouloir à créer cette équivoque. Je voudrais arriver à la dissiper.

Le titre d'Aryens est historiquement applicable aux Indo-Iraniens seuls. Ceux-ci étaient loin de former la partie la plus pure, au double point de vue morphologique et sociologique, de la race que nous appelons aryenne. C'est pourquoi je crois préférable de laisser le terme d'Aryen à l'histoire et à l'ethnographie, et de lui conserver son sens strict, plutôt que de continuer à l'étendre comme on l'a fait, d'abord en philologie d'un sous-groupe à un groupe entier de populations parlant des langues apparentées et pratiquant des coutumes analogues, et ensuite en anthropologie à la race qui parait avoir joué chez ces peuples le rôle de ferment. En regardant comme démontré ce qui est encore discuté, à savoir que les langues et les idées aryennes sont nées dans une tribu ou dominait la race blonde et sous l'influence de son génie propre, faire remonter d'une partie des peuples conquis au premier noyau des conquérants un nom ethnique plus récent d'un nombre considérable de siècles, c'est à peu près comme si l'on voulait dans dix mille ans appeler les Francais d'aujourdhui Dahoméens, parceque l'Afrique serait en grande partie devenue, c'est une pure hypothèse, francaise de moeurs et d'institutions.

Il conviendrait de s'entendre pour adopter désormais dans le langage précis la terminologie suivante: Aryens, les Indo-Iraniens primitifs; langues aryennes, institutions aryennes, les langues et les institutions de ces peuples et de leurs descendants immédiats; Indo-Européens, les peuples, d'origine quelconque, qui ont fait usage de ces langues, et de ces institutions, mais à partir seulement du moment ou cet usage a commencé chez eux. La terminologie ainsi rétablie, on arrive à s'apercevoir que le problème aryen n'existe pas et qu'il y avait simplement logomachie. On se trouve en face des questions suivantes, aux quelles il est plus facile de répondre dès que l'esprit n'est plus tiraillé par les acceptions multiples et discordantes des termes.

Quel a été le berceau des langues et des institutions indo-européennes? Question d'histoire et de philologie, à laquelle on est actuellement porté à répondre: l'Europe.

Ces langues et ces institutions paraissent elles avoir été particulièrement propres à certains peuples caractérisés par la prédominance d'une race, et laquelle? Autre question d'histoire et de philologie à laquelle on est obligé de répondre: oui, la race dolichocéphale blonde. En effet il n'y a pas de peuple ou cette race domine qui fasse usage de langues ou d'institutions non-aryennes, tandis que les peuples ou cette race ne domine pas font en partie usage de langues ou d'institutions d'un autre groupe, en ont fait usage à une époque historique rapprochée (partie de la Russie et de l'Allemagne), ou paraissent en avoir fait usage dans l'antiquité (Gaule, Espagne).

L'évolution qui a produit ces langues et ces institutions a t'elle eu pour point de départ un peuple ou la race blonde avait la supériorité soit numérique, soit sociale? et paraît elle le fruit du génie de la race? Question délicate, car il faut juger d'après des probabilités soulement, mais à laquelle il est permis de répondre oui.

Quel a été le berceau de la race dolichocéphale blonde? Question d'archéologie préhistorique et de physiologie. Réponse: c'est la région où le type ostéologique le plus voisin du type dolichocéphale blond s'est trouvé soumis aux conditions météorologiques nécessaires pour le réduire à un état voisin de l'albinisme.

Où doit etre localisé ce berceau? le type dolichocéphale blond se rattachant par le squelette aux races quaternaires et néolithiques de l'Europe occidentale son berceau ne peut être cherché qu'en Europe, les conditions nécessaires d'inactinisme et d'humidité permanente qui ont déterminé sa décoloration ne se sont trouvées réalisées que dans la région voisine de la Mer du Nord, à la fin du quaternaire, et mieux encore dans la partie de cette mer alors exondée.

On arrive ainsi aux propositions suivantes:—

Le type polichocéphale blond, *H. europæus*, Linné, abusivement appelé aryen, s'est développé dans le N. O. de l'Europe, telle quelle était à la fin des temps quaternaires, par l'action des milieux sur les races dolichocéphales indigènes, ou sur une seule de ces races. Il s'est fixé par un long séjour dans ces régions. Il en est sorti par des émigrations successives à mesure que le sol s'engloutissait sous ses pieds.

Les langues et les institutions indo-européennes se sont formées quelque part en Europe sous l'action du génie de la race blonde. Cette formation est de date relativement récente, et si les blonds ont apporté de leur primitive patrie une langue proto-aryenne, elle était à un stade d'évolution qui ne permettrait probablement pas d'en reconnaitre la nature. On sait la rapidité avec laquelle varient les langues non écrites. L'état des langues indo-européennes prouve d'autre part leur origine récente.

Les langues et les institutions indo-européennes ont été ensuite implantées dans les deux tiers de l'Europe et dans une petite partie de l'Asie, par les conquêtes des peuples qui en faisaient usage. Un peuple passé probablement d'Europe en Bactriane par la mer Caspienne, ou Asiatique mais conquis par des Européens a porté les langues et les institutions indo-européennes dans l'Inde. A ce rameau seul appartient le nom d'Aryen.

Tout s'éclaircit donc dès qu'on n'embrasse plus ensemble la question d'origine des langues aryennes et celle de la race blonde, dès qu'on ne confond plus les peuples indo-européens avec les blonds, conquérants d'abord, puis absorbés et devenus classe dirigeante chez des peuples de race différente.

THE SCIENTIFIC ALLIANCE OF NEW YORK.

BY JOSEPH F. JAMES, M. SC., WASHINGTON, D.C.

The "Scientific Alliance of New York" is composed of the following societies: New York Academy of Science, Torrey Botanical Club, New York Microscopical Society, Linnæan Society of New York, New York Mineralogical Club, New York Mathematical Society, New York Section of American Chemical Society.

Two meetings have been held, of which the proceedings have been published, and as the scheme seems to mark an era in scientific matters, especially in New York City, and as it is one that is likely to result in permanent benefits to science, a notice of it does not seem out of place.

The council of the Alliance is composed of the president and two members of each of the component societies. Its president is Charles F. Cox, and its secretary and treasurer N. L. Britton. The first meeting was held on November 15, 1892, and at it addresses were made by various prominent men. Hon. Seth Low, President of Columbia College, spoke upon the advantages to the city of New York of the Alliance, and he was followed by Mr. C. F. Cox with an address on the advantages of the alliance to the scientific societies. Mr. Cox pointed out the necessity of coöperation by the various organizations if the best results are to follow. He referred to the fact that the real materialists of the world are the so-called practical men, who measure scientific knowledge by commercial standards and in whose eyes science "is worth only what it will bring when offered in the form of dynamos, telephones, electric lights, dye stuffs, mining machinery and other merchantable wares." The object of the Alliance he held to be to furnish a sort of common ground (may we call it a clearing house?) where knowledge of what is being done in one society is conveyed to all the rest, and in this way all are kept posted in regard to what is going on and duplication of work is thereby avoided.

The third address was by Hon. Addison Brown on the need of endowment for research and publication. He referred to the example set by Professor Tyndall, who established three scholarships with $30,000 received by him from a series of lectures delivered in this country. He has been followed by others with equally munificent gifts. He pointed out the necessity to the practical man of work in the region of pure science, but as the workmen in this region are generally those who have neither the time nor the means for original research, the necessity for an endowment to enable them to continue their work is evident. Reference was made to the difference between the German universities, where the professors are expected to do original work, leaving the teaching for instructors, and the American so-called universities and colleges where the professors seldom have the time to devote to anything outside of mere routine work. He mentioned the humiliating fact that at the Zoölogical Station at Naples, where Germany and Italy each maintain eight tables, Russia, Spain, Austria, and England three each, and Switzerland, Belgium and Holland one each at a cost of $500 per annum, the United States had none, and has been dependent heretofore upon the generosity of foreign nations for the occasional use of a table. This loss is not compensated for by the fact that there are several small laboratories along the Atlantic coast of this country. The endowment of research through fellowships in colleges was also considered, and lastly a detailed reference to scientific societies in this country and England. The comparison is not flattering to our pride. In England the property, funds and equipment of the societies is nearly ten-fold greater than in America. The publications are double. No laboratories and no professors are maintained here for original research. "The English societies," he said, "distribute yearly from $25,000 to $35,000 for from sixty to seventy-five different scientific purposes, while ours make *no* such appropriations simply because there are no funds."

Dr. H. Carrington Bolton, in his plea for a library of science in New York, gave many interesting facts relative to libraries of New York and its sister cities, arguing in favor of bringing together under one roof all the libraries of the societies in the Alliance. These libraries aggregate 13,700 volumes and would form an excellent nucleus for a scientific library. Reports received from sixty libraries of New York and its vicinity show that there are 1,916,000 volumes in them, the scientific books varying from 5 to 100 per cent. Fifteen of the libraries have over 40,000 volumes each. To house the libraries Professor Bolton outlined a plan. He advised having a building 100 × 120 feet square, four stories high in front, with a lecture room, in the rear, large enough to seat 1,000 persons. The library room should have shelves to accommodate 300,000 volumes. There should be an office for general business, several small rooms for ordinary meetings of the separate societies, photographic and microscopic laboratories and a general reception room. The plan is extensive, but let us hope that some wealthy New Yorker may make it feasible.

The second joint meeting of the Alliance was held on March 27, 1893, in memory of Dr. J. S. Newberry. The important business transacted after the reading of a memoir by Professor H. L. Fairchild, was a report of a committee recommending the establishment of an endowment fund of $25,000 for the purpose of encouraging original research. The fund is to be known as the John Strong Newberry Fund, and is to be administered under the direction of the Council of the Scientific Alliance. Blank forms for subscriptions of any amount will be cheerfully furnished by Dr. N. L. Britton, Columbia College, New York. The money will be used for furthering researches in geology, paleontology, botany and zoölogy, in all of which subjects Dr. Newberry was interested. About $600 in sums varying from $5 to $100, had been subscribed about a month ago.

A NOTE ON THE APPLICATION OF SCIENTIFIC METHOD TO LITERATURE.

BY C. MICHENER, SAN FRANCISCO, CAL.

PEOPLE have lately begun to study literary products inductively; but that study has been almost entirely systematic. Words, sentences, paragraphs, figures of speech, etc., are counted and classified, and from the results obtained some slight conclusions are drawn as to the development of style. This is undoubtedly good work. But it is easy work and perhaps it is on that account that we so readily see that it is good.

In the present paper I wish to propose something more difficult. I wish to indicate the use of a science as a tool in the study of literary products scientifically. The history of any science is a story of development by stages, each successive stage of advance caused by the application of another department of science to the investigation of the one in question, for example, mathematics to electricity.

Literature is a product of the mind, and its use and purpose are by and for the mind. Is it not then intimately connected with psychology, and should not an investigation and comparison of the facts of each be of benefit in determining the laws of each?

Let us take, for example, that exceedingly important part of most literary products, Plot. As an outline for the study of plot (not to be confounded, of course, with plot content), I would propose the following: —

(*A.*) *The psycholgical bases of plot.* Here the main part of the work is to be done. The exceedingly delicate mental phenomena included loosely under such terms as attention and interest are to be investigated by experiments as wide in range as possible; and from all this should result facts enough for the construction of the ideal plot and the determination of its structure. This we might call

The typical plot, that is, plot stripped of all accidental factors and limitations. The next step would be to consider the various adaptive modifications which this typical plot would undergo when subjected to the restraints and environment of the various great classes of literary products; and our investigations under the first head, and I think I may say such investigation only, will enable us to understand the differentiation. We should thus be led to consider the plot of the lyric, the epic, the drama, the novel, etc.

B. The temporal development of plot. Here we should commence from the other end as it were, and from the existing literary products trace the growth of plot from its beginning to the present; and from these records obtain the history of the development of those mental functions which plot presupposes. This second division is the natural and necessary complement and check of the first and should be as useful to psychology in this department and, in an analogous way, as paleontology is to zoölogy or botany.

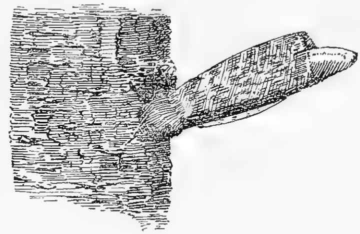
That the method here outlined is merely tentative I confess. It would, of course, be severely limited and the conclusions impaired by any limitation in the range of experiments under the first head; and in the present state of scientific psychology to be at all possible, the method would have to be materially modified to produce any result at all. I have, however, in this present note, only attempted to be suggestive, not conclusive.

LETTERS TO THE EDITOR.

A Case of Protective Mimicry.

THIS morning, as I was passing a small apricot tree standing in my yard, my attention was arrested by what appeared to be a short stub of a branch, about 1¼ inches long, projecting from the side of the tree about 20 inches from the ground. Having recently pruned the tree carefully, I wondered how I had happened to leave that stub, and at once applied my pocket-knife to remove it. Much to my surprise, I found that the supposed stub of a branch was a moth attached by its head to the side of the tree. The accompanying sketch represents its appearance.

The grayish-brown mottled color of the closed wings of the moth matched the color of the bark completely, and the angle made by the axis of its body with the tree was such as a branch would naturally make. It was attached with its ventral surface uppermost, and the extremity of the abdomen, which projected beyond the closed wings, was nearly white, as seen from above, thus imitating very perfectly the central woody portion of the broken branch. Having turned the moth over in my attempt to remove the supposed branch, it assumed the natural position of such insects on the side of the tree, but upon returning a half-hour later I found it again in the position shown in the figure. Several



other persons who saw it were as completely deceived by its appearance as I had been, and it is easy to believe that the keen eyes of a hungry insect-eating bird might see there only the stub, and thus be cheated out of a breakfast. GEO. H. COLTON.

Hiram, O., June 11.

A Maya Month Name.

As every additional find in reference to the Maya manuscripts is of interest to some of the readers of *Science*, I submit the following item.

In the bottom line, Pl. 46, Dresden Codex, is the glyph shown in Fig. 1, which, as all students of these Codices admit, is the symbol for the Maya month *Kayab*. Here it is without the appendage which sometimes accompanies it. In Fig. 2, from the bottom line of the Dresden Codex, Plate 61, the form is more complete, and the appendage is present.

The signification given by Perez to the name of this month is "singing," from the Maya word *Kay*, "to sing, to warble," but a study of the symbol leads to quite a different interpretation. According to the interpretation heretofore given by me (*American Anthropologist*, July, 1893, p. 246) the character in the upper right-hand corner of the glyph has *b* as its chief phonetic element,

which is also one of the consonant sounds of the word *Kayab*, and the appendage is the month determinative. But I was unable at the time the article referred to was written to indicate the portion of the symbol denoting the *k*' element. A more thorough examination, as given in Fig. 2, has called my attention to the fact that in the left portion and general form we have precisely the symbol for *Aac* (*Ac*, *Ak*), the "turtle," as given in the upper division of Plate 17, Cortesian Codex. Following this interpretation, the true name of the month is *Acyab* or *Akyab*, which, for the sake of euphony, has been changed to *Kayab*. The derivation, according to this interpretation, will be from *Ac* or *Ak*, "turtle," and *Yab* or *Yaab*, "many, abundant, plentiful." Adding the month determinative, we obtain as the full signification, "The month when turtles abound." Whether or not turtles are most abundant on the coast of Yucatan during the month of June I am unable to say. The only evidence I have at hand relating to the subject is found in Mrs. LePlongeon's charming little work, "Here and There in Yucatan." In this she describes a trip along the coast in June, at which time turtle catching was in progress and attended with great success, the fishermen's pens being full. Dr. Schellhas (*Zeitschrift für Ethnologie*, 1892) notices the resemblance of this character to the turtle symbol.

This apparently furnishes, at least, a straw pointing in the direction I have been moving in my study of the Maya hieroglyphs.

CYRUS THOMAS.

Washington, D.C., July 15.

Historical Statements in Century Dictionary Contradicted by Other Authorities.

Napier's rods (or bones), a contrivance commonly attributed to John Napier (1550–1617), but in fact described in the Arithmetic of Oronce Finée (1532).—*Century Dictionary* under *rod.*

Die erste Beschreibung gab Nefer in seiner Rabdologia (Edinburg, 1617).—*Vorlesungen über Geschichte der Mathematik*, von Moritz Cantor, zweiter Band, Seite 660.

The earliest known writers on the subject (magic squares) were Arabians, among whom these squares were used as amulets.—*Century Dictionary*, under *magic.*

The earliest known writer on the subject was Emanuel Moscopulus, a Greek, who lived in the fourth or fifth century, and whose manuscript is preserved in the National Library at Paris. —*Encyclopedia Britannica*, under *magic squares.*

These seem to me to be contradictions. I should be glad to see the truth in regard to these historical facts plainly set forth by a reader of *Science.*

GEO. A. MILLER.

Eureka College, Eureka, Ill., July 24.

The Cambojan Khmers.

OWING to some irregularity in the postal delivery I have only just received *Science* for June 9, else I should have sooner asked leave to put in a claim of priority in connection with Dr. Maurel's new views regarding the "Aryan" origin of the Khmers, referred to by Dr. Brinton in that issue. Personally I avoid the expression "Aryan or Indo-European stock" as confusing and applicable far more to linguistic than to ethnical groups. But if "Caucasian," used in Blumenbach's sense, be substituted for "Aryan" Dr. Brinton will find, by consulting the Transactions of the British Association for 1879, that fourteen years ago I conclusively showed that the Khmers should be grouped not with the surrounding Mongolic, but with the Caucasic division of mankind. In the "Monograph on the Relations of the Indo-Chinese and Inter-Oceanic Races and Languages," read before the association, and again before the Anthropological Institute and printed in the journal of that society for February, 1880, and issued separately by Trübner at same date, I argued *generally* that "both of the great Asiatic types conventionally known as Caucasian and Mongolian, have from prehistoric times occupied the Indo-Chinese peninsula," and *particularly* that here the Caucasic stock is represented by the widespread Khmer group, that is to say, the Cambojans proper, the Kuys or Khmerdom ("original Khmers"), as the Cambojans call them, the Stiengs, Charays, Chams and many others, some still in the tribal state, some long civilized or semi-civilized. It is the civilized that mainly engage Dr. Maurel's attention, and that he rightly regards as Aryans (read Caucasians), but wrongly supposes to have migrated in comparatively recent times from India to Indo-China, "bringing with them the Aryan culture of that country as proved by the stately ruins of Ang-Kok (read Ongkor-Vaht)." There was no such migration "probably about the third or fourth century of the Christian era," for the Khmers are not recent arrivals, but the true aborigines, as shown by the presence of the Khmerdom and the kindred wild tribes, and also by their untoned polysyllabic speech, radically distinct both from the Indo-Chinese toned monosyllabic group and from the Indic (Sanscritic) branch of the Aryan, but closely allied to the untoned polysyllabic Malayo-Polynesian linguistic family.

This point, which I think I have established to the satisfaction of most ethnologists and philologists (Professor Sayce amongst others), is of far-reaching consequence. It affords the solution of the extremely difficult problem connected with the presence of Logan's "Indonesians," my Caucasians, side by side or intermingled with the true Mongoloid Malays throughout the Oceanic domain (Indian and Pacific Oceans). But my object here is merely to establish my priority claim for the American readers of *Science*, who are referred to the above quoted monograph for the detailed treatment of these interesting questions. A. H. KEANE.

79 Broadhurst Gardens, South Hampstead, N. W., July 21.

Sound and Color.

WITHOUT in the least doubting the accuracy of Dr. Wallian's curious observations respecting the appearance of color about the heads of public speakers, I would just suggest the possibility of another explanation.

I have myself frequently observed, when listening to various preachers, a patch of rich blue color near to the head of the speaker. I have always attributed this, however, to the well-known effect upon the retina of fatigue from the continued impression of one color giving rise to a phantasm of the complementary color. The face of a speaker is some tint of flesh color. The eye of the listener is fixed upon the face, and in a short time the complementary phantasm makes its appearance, always some tint of blue or purple, according to the complexion of the speaker.

This will not, of course, explain all the phenomena mentioned by Professor Underwood and Dr. Wallian, but it is a factor which should not be forgotten in discussing the subject.

F. T. MOTT.

Leicester, England.

BOOK-REVIEWS.

A Biographical Index of British and Irish Botanists. By JAMES BRITTEN and G. S. BOULGER. London, West, Newman & Co., 1893. 203 p.

MESSRS. Britten and Boulger have republished in book form their "Index of British and Irish Botanists." The matter originally appeared in the *Journal of Botany* from 1888 until 1891, but in 203 pages of the reprint a large amount of additional material is given. This is shown by the fact that 1,825 names are given in the volume, against 1,619 given in the *Journal of Botany*. In a succinct form and by means of a series of readily understood abbreviations there are given the dates of birth and of death, place of birth and death, place of burial, indication of social position or occupation, university degrees or titles or offices held, and dates of election to the Linnæan and Royal societies. Mention is also made of the whereabouts of any correspondence or MSS. and the existence of any herbarium or plants collected. Various biographical dictionaries, where further information may be obtained, are also referred to. Any portrait, original or engraved, and any genus, or, failing this, any species, dedicated to the person, is mentioned. From this it will be seen that a large amount of information is gathered within a small compass, and the volume will be of great assistance in looking up facts relative to any one of the 1,825 names included within its pages.

JOSEPH F. JAMES.

Washington, D. C., July 22.

AMONG THE PUBLISHERS.

HANN & ADAIR, Columbus, O., announce "A History of the German Language from the Earliest Times to the Present Day," by Chas. W. Super, president of the Ohio University at Athens. The purpose of the author has been to write a book that may be read with interest and profit by persons whose knowledge of German does not extend beyond the rudiments. It has been his aim to make duly prominent the common origin of the English and German languages and to use many facts of the former to elucidate those of the latter, so far as it can be done within the space at command. The book also discusses incidentally some phenomena common to all civilized tongues. By the same author is "Weil's Order of Words in the Ancient Languages Compared with that of the Modern Languages," published by Ginn & Co., Boston, Mass.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Wanted to exchange.—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence, Hand book for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St., Newark, N. J.

A complete set of Bulletins of U. S. Geological Survey, various reports and bulletins of surveys of Missouri, Arkansas, Minnesota, Alabama, Illinois, New York, Pennsylvania, Indiana, Ohio and Texas; iron ores of Minnesota; Wailes' Agriculture and Geology of Mississippi (rare). To exchange for periodicals and books on Entomology or for Lepidoptera. Rev. John Davis, the Deanery, Little Rock, Ark.

For sale or exchange.—A complete set of the report of the last Geological Survey of Wisconsin, T. C. Chamberlin, geologist. It consists of four large volumes, finely illustrated, and upwards of forty large maps and charts. Will sell for cash or exchange for a microscope. Address Geo. Beck, Platteville, Wis.

For sale or exchange for copper coins or rare postage stamps. Tryon's American Marine Conchology, containing hand colored figures of all the shells of the Atlantic coast of the United States. Presentation copy, autograph, etc. One vol., half morocco, 8vo, usual price, $25, postpaid, $15. Botany of the Fortieth Parallel of the Hundredth Meridian of the Pacific R. R. Survey. Other Botanical works and works on Ethnology. F. A. Hassler, M.D., Santa Ana, Cal.

I have a fire-proof safe, weight 1,150 pounds, which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

For exchange.—Hudson River fossils in good condition from the vicinity of Moore's Hill, Ind., also land and fresh water shells. Desire fossils and shells from other groups and localities. Address Geo. C. Hubbard, Moore's Hill, Ind.

I wish to exchange a collection of 7,000 shells, 1001 species and varieties, American and foreign, land, fluviatile and marine, for a good microscope and accessories. Address, with particulars, Dr. Lorenzo G. Yates, Santa Barbara, California.

Wants.

WANTED—Panorpidae, Myrmeleoninae, and literature on the same. Chas. C. Adams, Bloomington, Ill.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

DRAFTSMEN WANTED.—The Civil Service Commission will hold examinations on August 15 to fill two vacancies in the War Department; one in the position of architectural draftsman, salary $1,400, the other in the position of assistant draftsman, Quartermaster General's office, salary $1,200. The subjects of the architectural draftsman examination are letter-writing, designing specifications and mensuration, and knowledge of materials; of the assistant draftsman examination they are letter-writing, tracing, topographic drawing and projections. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

A YOUNG man who has been through the course in mathematics in Princeton University, wishes some tutoring this summer. Rates reasonable. Address P. H. Westcott, Cramer's Hill, Camden Co., N. J.

A GRADUATE of an American Polytechnic institution and of a German university (Göttingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St., Brockton, Mass.

AN experienced teacher in general biology wishes a position in a first-class college or university. Three years in post-graduate study. Extensive experience. Strong indorsements. Address E. W. Doran, Ph.D., 1327 G St., N. W., Washington, D. C.

SCIENCE

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NEW YORK, AUGUST 11, 1893.

BOTANY AT THE FAIR.

BY H. L. BOLLEY, FARGO, NORTH DAKOTA.

Aside from the extensive opportunities for notes and observations upon miscellaneous herbaria and growing plants, collected from all parts of the earth, which are open to visitors of the Fair, it may not be inappropriate to note some of the special attractions for such persons as are botanically inclined.

While the name *Horticulture* has the place of honor upon the great plant house in the west portion of the Park, the place is none the less of botanical interest. Indeed, if adverse criticism is at all deserved in this department, it would be along the line that it is more a huge botanic garden than a horticultural show.

The amateur botanist, who, at his place of training, has complained that he has not been afforded sufficient opportunity for observation upon varied plant life, may in this building introduce himself to almost all known varieties of cultivated flowering and ornamental plants, which are representative of all lands. It is useless to attempt citations. None shown, however, are of more interest than the specimens representative of dwarfing methods, as conducted by the Japanese gardeners.

Grasses: Each exhibitor, fully understanding the importance of grasses and forage plants in an agricultural exhibit, has made careful effort to have his State or region fully represented as to its capabilities of producing these lines of plants. The great agricultural hall and the different State and national buildings thus present, in the aggregate, a list of native and cultivated grasses, more extensive as to numbers and more properly prepared for educational effect as to their qualities, form, growth, characteristics, etc., than it has ever previously been possible for any one to examine. Many of the States have full displays in bunch form, showing all characters, roots, leaves and seeds; while, again, ordinary herbarium specimens are to be noted almost anywhere one may go in the agricultural exhibits.

College and Experiment Station Exhibit: Located in the southeast corner of the agricultural building is the collective exhibit of agricultural colleges and experiment stations. Here again in the botanical alcove the varied nature of the exhibits makes it probable that few may pass through without noticing something individually interesting. Necessarily, the above is arranged more for show purposes than as a working laboratory, yet very much of the best work that has been done at the different stations is here represented, either by work in actual operation, apparatus, or by results graphically displayed. There are numerous photographs and drawings representing results gained in accurate experimental tests, as, for example, graphic results in crossing, by L. H. Bailey; results obtained in spraying for potato rot, by L. R. Jones, and many others. Photographs are shown of European and other foreign botanists, together with nearly a full list of our experimental botanists.

All the more common plant diseases are represented by pathological specimens, drawings, microphotographs and maps of distribution. This exhibit is a most varied and interesting one, containing, aside from the numerous specimens representing rusts, smuts, mildews, bacterial diseases, etc., many illustrations of results gained in prevention of plant diseases, such, for example, as grape rot, apple scab, potato rot and potato scab.

Different methods of seed-testing are in operation, displaying, among others, the following pieces: Nobbe's apparatus, Kiel-Zurich-Geneva germinator, the North Carolina seedpan, and E. S. Goff's various improved appliances. There are also illustrations of water and sand cultures, and various appliances and specimens too numerous to be listed at this time, among which may be noted B. D. Halsted's weeds and weed seeds, an exhibit of root tubercules upon native legumes, good microscopic exhibits, and T. L. Scribner's complete micro-photographic outfit.

Plant Physiology: A case full of apparatus for the study of special questions in plant physiology, prepared by Prof. J. C. Arthur, is worthy of special notice by any one who may pass through the laboratory. With the exception of a few standard pieces, all the different appliances had their origin and construction in the Purdue laboratories, and in finish are elegant examples of student work. Only mention may be made of a few of the more interesting pieces. Suffice it to say that probably no laboratory in the country has at this time an equally interesting collection of original or modified pieces for this sort of work. Noticeable among these are the following: Respiration appliances, a modification of Sach's method for determination of amount of carbon dioxide exhaled by plants; an apparatus for the comparison of normal and intramolecular breathing of seedlings, and one to illustrate intramolecular breathing of yeast in an atmosphere of carbon dioxide gas; auxanometers of three types of construction; chuostats of common type and one of intermittent action. This last piece is new and original, of elegant construction, and is especially applicable to the study of the force of habit as evidenced in plant life. There are dynamometers of various types for measuring various plant forces; transpiration pieces, including a potetometer for the quantitative determination of the amount of water given off by a given leaf surface in a given length of time; a poroscope; root-pressure appliances, and many smaller pieces, which are quantitative in their results. With all these contents, this case is worthy of the close consideration of any person interested in plant physiology. If all the pieces are not as suited to their work as might be wished, they are at least much to be preferred to those with which most of us have worked, and indicate future possibilities of more accurate results in this field of botany. Finally, there is a chance for most interesting study in two bacteriological laboratories, each fitted with all the latest and more essential appliances.

BIOLOGICAL SURVEY OF INDIANA.

At the last meeting of the Indiana Academy of Science, at Terre Haute, a Biological Survey was established for the State of Indiana, and Prof. Lucien M. Underwood, Greencastle, Ind., Division of Botany; Prof. Carl H. Eigenmann, Bloomington, Ind., Division of Zoölogy; Prof. Vernon F. Marsters, Bloomington, Ind., Division of Palæontology, were appointed Directors to organize the survey and outline the preliminary work ordered by the Academy.

It is the purpose of the survey: (1) To ascertain what has already been accomplished in the direction of making known the character and extent of the life of the State, and to this end to prepare a complete bibliography of materials bearing on the botany, zoölogy and palæontology of Indiana, to be published by the Academy. (2) To associate the various workers throughout the State, and so correlate their labors that all will work together towards a definite end, and ultimately accomplish the main purpose of the survey, namely,—the making known of the entire fauna and flora of Indiana, its extent, its distribution, its biological relations, and its economic importance. (3) To stimulate the teachers of biology throughout the State to encourage in their pupils the accumulation of material, which shall make known the local extent and distribution of life-forms, and thus contribute facts that will be useful in the survey and at the same time develop acute observers for continuing the study of the natural resources of the State. It is thus intended that the colleges and secondary schools will form with the survey a mutually helpful relation. (4) Ultimately to secure for the Academy a collection that will illustrate the biology of the State. Until such collection can be otherwise provided for, the Academy will designate certain public or private collections where accumulated material may be deposited temporarily. Material sent to the directors will be thus held for the future disposition of the Academy.

It is earnestly requested that all persons interested in any department of biological work will place themselves in relations with the Directors of the survey at once in order that their work may be made to contribute the most effectively to the public good, and in order that the Directors may know on whom they may depend for gaining information from various portions of the State. All contributions from persons interested will be properly credited in the reports of the survey. Correspondence is solicited with the director of the particular branch in which any one is interested, and such directions in regard to collecting and sending material will be given on application. By the assistance of the Smithsonian Institution, the directors are able to send printed directions for collecting to such as apply for them. In ordering these it will be necessary to specify in what particular branch information is desired.

It is the purpose of the Division of Botany during the present year to make such additions and corrections to the published "Catalogue of the Plants of Indiana" as are possible, and to secure definite information regarding the distribution of such rare forms as are there published.

Specimens illustrating the distribution or occurrence of any plant within the limits of the State must be deposited with the survey before any notice of their belonging to the state flora can be published. This will insure the ability to verify in future any fact published by the survey. In sending such material it is desirable that notes on the station, habitat, range and abundance of the plant be noted, together with any other information that will be of value. In addition to the flowering plants and ferns covered in the above, it is the intention of the Division to commence the study of the distribution of the lower cryptogams, concerning which almost nothing has been published from Indiana. While collections will be made of all forms, special attention will be given at present to the study of (1) Mosses, (2) Hepaticæ, and (3) Parasitic Fungi. Specimens are earnestly desired of all species, even those that are most common, from all portions of the State. It is desirable to state with each species the data indicated above, with particular reference to the habitat. In the case of parasitic fungi, it is necessary to indicate the host and to include sufficient quantity of the host plant, that doubtful determinations may be verified. The Director has been promised the assistance of specialists in the study of material accumulated.

The leading aim of the Division of Zoölogy during the season will be the compilation of a complete bibliography of the vertebrates of Indiana and of as many invertebrates as can be provided for.

At the same time any material showing the distribution of animals in the State is especially desirable. To determine the distribution, complete collections of the vertebrates of as many localities as possible should be made. Collections should always accompany notes, so that the observations may be verified by some specialist.

No opportunity should be neglected to observe the breeding habits and seasons, and the animal with young should, whenever possible, be preserved and forwarded to the Director, who will transmit it to the proper authority for record.

Another subject which should receive attention is the migration, or seasonal appearance and disappearance of mammals, birds, reptiles and fishes.

The next meeting of the Australasian Association for the Advancement of Science will be held in Adelaide, South Australia, commencing on September 25. The Association has now been in existence since 1888. Four meetings have been held, viz.: In September, 1888, at Sydney—President, H. C. Russell, C. M. G., B. A., F. R. S., Government Astronomer, N. S. W.; in January, 1890, at Melbourne—President, Baron F. von Mueller, K. C. M. G., Ph. D., F. R. S.; in January, 1891, at Christchurch—President, Sir James Hector, K. C. M. G., M. D., F. R. S.; in January, 1892, Hobart—President, His Excellency Sir Robert Hamilton, K. C. B. The meeting in Adelaide will be presided over by Ralph Tate, F. L. S., F. G. S., Professor of Natural Science at the University of Adelaide. Since its commencement the Association has grown steadily and now numbers about 900 members. The work is divided into sections as in the British Association, whose rules on most points have been closely followed. The Presidents of sections for the Adelaide session are: Section A.—Astronomy, Mathematics and Physics: H. C. Russell, C. M. G., B. A., F. R. S., Government Astronomer of New South Wales; Section B.—Chemistry: C. N. Hake, Chief Inspector of Explosives, Victoria; Section C.—Geology and Mineralogy: Sir James Hector, K. C. M. G., M. D., F. R. S., Director of the Geological Survey of New Zealand; Section D.—Biology: C. W. De Vis, Curator of the Brisbane Museum; Section E.—Geography: A. C. Macdonald, F. R. G. S., Hon. Secretary of the Victorian Branch of the Royal Geographical Society of Australasia; Section F.—Ethnology and Anthropology: Rev. S. Ella, New South Wales; Section G.—Economic Science and Agriculture: H. C. L. Anderson, M. A., Director of Agriculture, New South Wales; Section H.—Engineering and Architecture: J. R. Scott, Lecturer-in-Charge of the School of Engineering, Canterbury College, Christchurch, New Zealand; Section I.—Sanitary Science and Hygiene: A. Mault, Secretary to the Central Board of Health, Tasmania; Section J.—Mental Science and Education: Henry Laurie, LL. D., Professor of Mental and Moral Philosophy at the University of Melbourne.

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

PROGRESS IN SANITARY SCIENCE IN MASSACHUSETTS.

BY GEORGE W. FULLER, LAWRENCE, MASS.

THE State Board of Health of Massachusetts, in addition to the ordinary duties devolving upon such a Board, have made much progress during the past six years in the study of many important problems in sanitary science.

In 1886 the Legislature made provisions (Chap. 274 of the Acts of 1886) that "the State Board of Health shall have the general oversight and care of all inland waters. . . . Said Board shall, from time to time, as it may deem expedient, cause examinations of the said waters to be made for the purpose of ascertaining whether the same are adapted for use as sources of domestic water supplies or are in a condition likely to impair the interests of the public or persons lawfully using the same, or imperil the public health. It shall recommend measures for prevention of the pollution of such waters, and for removal of substances and causes of every kind which may be liable to cause pollution thereof, in order to protect and develop the rights and property of the Commonwealth therein and to protect the public health. It shall have authority to conduct experiments to determine the best practicable methods of purification of drainage or disposal of refuse arising from manufacturing and other industrial establishments. For the purposes aforesaid it may employ such expert assistance as may be necessary.

"It shall from time to time consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply or sewerage, as to the most appropriate source of supply, the best practicable method of assuring purity thereof or of disposing of their sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. All such authorities, corporations, firms and individuals are hereby required to give notice to said Board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage or refuse."

The Legislature in 1888 made further provisions (Chapter 375 of the Acts of 1888) that "all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage, shall be accompanied by a copy of the recommendation and advice of the said Board thereon."

In compliance with these provisions there was established by the Board an engineering department, whose main work may be divided into two classes: (1) The examination of proposed plans or schemes of water supply or sewerage submitted by the various cities and towns; (2) the examination of existing water supplies and inland waters of the State with reference to their purity.

With regard to the work of the first class it is to be noted that from July, 1886, when the act relating to water supply and sewerage first went into operation, up to January 1, 1893, there have been received 228 applications for advice. In the course of the investigations, instituted to develop the facts required as a basis for sound advice to the cities and towns, many valuable data have been obtained. The capacity, when fully developed, of sources of water supply drawn from ponds, lakes and streams, has been studied individually and in relation to the future needs of the great centres of population. Probable and comparative costs of different systems have been made; drainage areas have been surveyed, records of rainfall, temperatures, rates of increase of population and of consumption of water per capita have been kept and studied. All of these data have not only been of aid in the past but are also of great value for future reference.

Beginning in June, 1887, monthly analyses have been made of water from all the water supplies of the State, and of the more important rivers and other inland waters. At the outset every public water supply was visited by the engineers of the Board; a description and history of the different works were obtained; places for taking samples of water were chosen, and methods to be followed were explained to local officials. Much information was also gathered with regard to the physical characteristics of the water supplies,—such as the density of population on drainage areas, amount of polluting matter entering the streams, volume of water flowing, and temperatures of water. In addition to the chemical analyses which are made in the laboratories of the Board in Boston, at the Massachusetts Institute of Technology, examinations are made of the grosser forms of microscopic life, with the view to establish the relation between the micro-organisms and odors present in certain drinking waters. Bacterial analyses are also made from time to time.

Carefully prepared reports have been made of the results of these investigations. An idea of the nature of the work done can perhaps be best learned by looking at the following list of subjects, which are among those discussed in the annual and special reports:—

A Summary of Water Supply Statistics.

Classification of the Drinking Waters of the State.

Examination of Spring Waters.

Pollution and Self-Purification of Streams.

Typhoid Fever in its Relation to Water Supplies.

Suggestions as to the Selection of Sources of Water Supply.

Dissolved Oxygen in Waters of Ponds and Reservoirs at Different Depths.

Effect of Aeration of Natural Waters.

The Relation of Organisms and Odors in Natural Waters.

The Seasonal Distribution of Organisms.

In 1887 the Board established an Experiment Station at Lawrence. The object of this was to learn how to purify sewage and water. The Station was designed and its work planned by Mr. Hiram F. Mills, A. M., C. E., chairman of the Committtee of the Board on Water Supply and Sewerage.

Experimental filters were constructed of different materials, such as would be found in suitable filtration areas throughout the State. Each filter, however, consists of a single material. The experiments were so conducted as to throw as much light as possible upon the laws of filtration. The degree of purification of sewage and of water by the sands of different coarseness, the quantities which the different materials are able to purify, the best method of operation of filters of different construction, and the treatment necessary under varying conditions arising from different lengths of service of the filters and from the effects of weather have been investigated. Much attention has been given to the physical characteristics of materials which govern their action as filters. The open space between the sand grains, the capillarity and the frictional resistance to the passage of water, etc., have been determined for many materials.

Knowing, from the results of these experimental filters, the degree of purification of sewage and of water effected by each of a series of materials ranging from fine loam to coarse gravel, and having formulated the physical characteristics of these materials which govern their action as filters, it is now possible, by studying the physical characteristics of materials sent to Lawrence by cities and towns desiring to adopt filtration, to predict with reasonable accuracy what their efficiency will be as filters. From this it will be readily seen that these investigations do away, in a large measure, with the experimental nature which would otherwise be attached to the operation of large and expensive filter plants. The object of the Lawrence Experiment Station, in short, is to study the laws of filtration with a view to economy.

In regard to the efficiency of filtration, it may be stated, in passing, that sewage can be applied to areas of coarse (mortar) sand 5 feet deep, at a rate of 120,000 gallons per acre daily, with a removal of 95 per cent of the organic matter and germs in the applied sewage. With finer sand the purification is still more complete, but the quantity which can be successfully treated is less. By means of chemical precipitation it is possible, under the most favorable conditions, to remove only from one-half to two-thirds of the organic matter from sewage.

One of the most important points in water purification is the removal of disease-producing germs, since it has become clearly established that high death-rates from diseases, caused by germs which can live in water, result largely from drinking polluted water. The results of the Lawrence experiments show that it is possible to construct filters which will purify at least 2,000,000 gallons of water per acre daily and remove more than 99 per cent of the bacteria in the unfiltered water.

The theory of filtration and a large amount of information upon the actual operation of filters have been presented in the annual reports of the Board and in the special report upon Purification of Sewage and Water, 1890—a volume of 881 pages.

Large sewage filters are in successful operation at Framingham, Marlborough and Gardner, in this State, and others are in the process of construction. A large filter, also, to purify the water supply for the city of Lawrence, is nearly completed.

It is interesting to note the increasing confidence with which this work of the Board is regarded by sanitarians and engineers, not only in this State but throughout the United States and in foreign lands.

The advance in methods of analysis is worthy of note, and more especially in the interpretation of the results of analysis. Old methods have been improved and new ones devised, as well as some pieces of apparatus, which it is believed are not to be found outside the laboratories of the Board—except at their exhibit in the Anthropological Building at the World's Fair.

ASEPSIS—PREVENTION BETTER THAN CURE.

BY ALBERT S. ASHMEAD, M. D., NEW YORK.

There is a singular agreement of precept between some of our new philosophical schools and the doctrine of the Orientals as to our duty to the race in case of disease. The doctrine of our philosophers, teaching the survival of the fittest, and our duty to the race, not to interfere with the eliminating operations of nature, is not put into practice, and considering that Christianity is our religion and is not looking forward at present to any imminent decline, it is not likely to pass into practice for some time to come. The Orientals criticize Christianity because it seems unduly and undutifully occupied in counteracting the decrees of nature, by saving, with fostering care, individuals of the race, preserving in hospitals all that ought to perish, and heaping up, so to speak, the sweepings of nature, to perpetuate moral and physical uncleanness. True, they also are anxious to build hospitals; but if they were let alone perhaps they might build them only for animals, whose races are not important enough to make it a pity that disease and vice should be allowed to be transmitted among them from generation to generation. Wherever the Oriental spirit has developed on its own lines, it has endeavored to eradicate the human weed, to sweep away all human influences detrimental to mankind, whether they be represented by disease or by crime, always ready to sacrifice any man to the interest of men. The leper was cast out to die with his disease in unpitied misery and solitude; the beggar, unable to earn his bread or support his family, was excluded from help and intercourse of any kind; what could the race expect from his seed? What is the use of amputating a limb which tuberculosis or syphilis or leprosy is gnawing at? Why should his seed be preserved to perpetuate his rottenness? Why should we so tenderly humor the madman, use infinite care and infinite treasures of knowledge, and miracles of skill, to bring the diseased brain into a condition which makes the man innocuous, tolerable, while yet he can never be normal, rational, useful; his brain fibre is degenerated and should not be transmitted to future generations.

When we Westerners discovered the bacterium we thought that here we had the cursed cause of all disease, and forthwith began to give her chase or to lay siege to her citadel. The Oriental may have thought dimly: Wherever you are, O, Microbe, you are in the state where Providence has placed you and must do her behests. Yours is the empire of the abnormous, the morbid, the destructive. Whatever part of creation you establish yourself upon is by your very presence stamped as bad, unhealthy, undeserving of existence. Therefore stay in your domain, we do not envy it to you. Eat up what belongs to you, it can do us only harm. These Eastern populations believe in fate; they are the true Stoics. What is written, is written, Kismet. If we are doomed to be cut off by cholera we shall not escape it, and the fear of the inevitable shall not prevent us from plunging our limbs into the lethal waters of the Ganges, or quenching our thirst in the Mecca pools. And what does it mean, that our own people, not very long ago, considered the use of vaccine as being an interference with the will of Providence. They called Providence what in the Orient we call fate. It would seem that medicine in general is just the opposite of this magnificent supineness: the physician tries to save his individual, let what may become of the race; there is another kind of recklessness, not supine like the Oriental, but busy and officious. It would be a much higher task, if, instead of waging war against the bacillus, who has invaded an individual, medicine should find means to obviate and suppress the bacillus, or its development, or its culture, before it invades the race by the individual, that is, should create in the organism such conditions, should produce such constitutions, as would not allow of the existence of these microscopical pestilences. That would be asepsis instead of antisepsis. Here is what asepsis has to do. It stands at the fountain head, its mission is to keep the spring of life free from impurity. Let a commission, or whatever body of scientific information and action, go to Russia, to the original habitat of the typhus germ, oppose the development of its colonies before they begin their trip around the world. The first thing to do will probably be to improve the condition of the Russian Jew. Prevent the Hindoos from poisoning themselves with their holy water, with which they drink the blessing of cholera. Enact laws to isolate the syphilitic and the tuberculous. Prohibit the marriage of such. Let the congenitally incurable die before puberty: it is better that the offending limb should be lost than that tuberculosis, syphilis, leprosy, etc., should spread through the whole body. Let the healthy, the temperate, the moral, alone have the inheritance. A correct life is the most perfect asepsis, and insures an immunity with which the burnt infant's immunity, known as such, cannot compare.

THE "GOPHER FROG."

BY FREDERICK CLEVELAND TEST, U. S. NATIONAL MUSEUM, WASHINGTON, D. C.

THROUGH the kindness of Mr. H. G. Hubbard, of Crescent City, Florida, I am enabled to make a note on the habits of the "gopher frog," *Rana areolata æsopus*, Cope. This form seems to be so rare in collections that so far the only specimen reported as having been identified with this sub-species is the type in the National Museum, from Micanopy, Florida, and described by Professor Cope in the Proceedings of the American Philosophical Society for 1886. I have been unable to find any published mention of its habits, which are peculiar.

It appears to be almost entirely subterranean in its habits, living in the holes and burrows of the "gopher" turtle, *Gopherus polyphemus*, in conjunction with it, and apparently on the best of terms. Roughly described, it is grayish green, with thirty-five or forty ragged black spots arranged in four or five irregular longitudinal rows on the back, and grading off into smaller spots on the flanks, while the legs are barred with about fifteen half-rings of black, from the thighs to the toes. Beneath it is white, with the throat marbled with very dark brown. The body is rather flat, with wide head and sharp-pointed snout, and the two dorso-lateral ridges, together with indicated folds between them, are greenish brown. The size is about that of a small "leopard frog," *Rana pipilus*, or the "swamp frog," *Rana palustris*, to which last it is closely related, although individuals are said to have been seen weighing two or three pounds. But those must have been huge toads, noticed by persons unable to distinguish between them and the frogs, or too unobserving to make the distinction. Its food has not been ascertained, from dissection of the stomachs of freshly captured specimens, but as these frogs are rarely seen away from the burrows, it is probable that they feed on the insects living in the burrows, for the holes possess a flourishing insect fauna, to a great extent peculiar to them.

On cloudy and rainy days the frogs sit at the mouths of the burrows—as many as three have been found in a single burrow—but on the approach of a human being dive down out of sight, and as the holes are from 12 to 20 feet in length, and 7 or 8 in vertical depth at the end, digging the frogs out is no easy matter, especially as the sandy soil has a tendency to cave in on the excavator. But the frogs may be successfully angled for with a fishing line and small hook baited with a grasshopper.

In the fact that the burrows usually or always go down to water, may be found an explanation of the frogs inhabiting them, and the facility of procuring insect food therein may be an additional inducement, as well as their being safe hiding places. Nothing seems to be known of the habits of the other varieties of the species, of which also but few specimens are known, *Rana areolata areolata*, from Texas and Georgia, *Rana areolata capito*, from Georgia, and *Rana areolata circulosa*, the "Hoosier frog," found in Indiana and Illinois. It is to be hoped that further observations will be made upon this interesting species, and additional specimens collected.

ALTITUDE AS THE CAUSE OF THE GLACIAL PERIOD.

BY WARREN UPHAM, SOMERVILLE, MASS.

Among the numerous difficult questions which are now being investigated and discussed by glacialists, none seems more important or worthy of attention than the cause, or the causes and conditions, which produced the Glacial period, with its very exceptional accumulation of ice-sheets upon large continental areas in the north and south temperate zones. Climatic conditions like those to-day prevailing in Greenland and on the Antarctic continent, both now covered by ice-sheets whose central portions are several thousands of feet thick, then prevailed in North America as far south as to Long Island, New York, Cincinnati, St. Louis, Bismarck and Seattle, reaching to a more southern latitude in the moist eastern half of the United States than in its mostly arid western half. Likewise Scandinavia, Great Britain south to London, Germany south to Berlin, and the northwestern half of Russia, were enveloped by ice. The glaciers of the Alps, too, of other European and Asiatic mountain ranges, of the Rocky Mountains, and of the mountains of New Zealand, were far more extensive than now; and in South America a broad ice-sheet covered Patagonia.

Three chief theories have been proposed to account for the great climatic changes made known to us by the extent of these areas of glacial drift. During the past twenty years all glacialists have been greatly interested in the astronomic theory of Dr. James Croll, so ably advocated by him in his volume, "Climate and Time," and by Prof. James Geikie in "The Great Ice Age," attributing the ice accumulation to climatic conditions attendant upon an epoch of maximum eccentricity of the earth's orbit. American glacialists, like those of Great Britain and continental Europe, were several years ago very generally inclined to think that this was a true and sufficient explanation. At the present time, however, a majority of the advanced students of this subject, at least in America, doubt that this theory is applicable to the observed facts of glaciation. For, in accordance with Dr. Croll's view, glacial periods should be recognizable with geologic frequency through the earlier Tertiary and Mesozoic eras, where, on the contrary, evidence of glacial conditions is wholly absent or exceedingly scanty, being wherever it is known probably referable to Alpine rather than continental glaciers. Besides, it seems within the past ten years to be fully ascertained that the time since the disappearance of the ice-sheets of North America and Europe has been only 6,000 to 10,000 years, whereas if they had depended on the astronomic causes mentioned their departure must have occurred some 80,000 years ago.

A second theory, accounting for the Glacial period by changes in the position of the earth's poles, and consequently in the latitude of the countries glaciated, which was first proposed by Sir John Evans in 1866, has therefore lately attracted the favorable consideration of some American glacialists, and in Europe has been championed by Nansen in his very interesting work, "The First Crossing of Greenland." This theory supposes that within so late a part of the earth's history as the Ice age, the north pole may have moved to the region of southern Greenland and returned, giving in the period of its digression glacial conditions for all the lands adjoining the North Atlantic Ocean, and the same for the antipodal, then south polar, portion of the globe. A small observed variation of latitude, discovered several years ago by German and Russian astronomers, seemed to give a foundation for this view, but within the past two years the brilliant investigations of Dr. S. C. Chandler, showing that these variations are of very small amount and in two short periods, one of fourteen and another of twelve months, while no appreciable secular change of latitude can be recognized, leave to us no basis for this theory of the cause of accumulation and disappearance of ice-sheets.

The third theory, which the writer believes to be applicable, sufficient and acceptable for all the observed facts of the Glacial period, attributing the ice-sheets to high altitude of the drift-bearing countries, has also been long under consideration, having been first suggested in 1855 by Dana, but failed until recently to receive adequate appreciation on account of the supposed geologic improbability of sufficiently high uplifts of so extensive portions of the earth's surface. During the past few years, however, this neglected theory has received full attestation by independent evidence, apart from the facts of glaciation, that these countries, and also other parts of the terrestrial coast, have been, in the same late geologic era which includes the Ice age, raised thousands of feet above their present height, to altitudes doubtless having so cool climate as to bring snowfall during nearly the entire year, the most favorable condition for the formation of ice-sheets. This evidence consists chiefly in the very great depth found by soundings in fjords and the submarine continuations of river valleys, where streams flowed formerly and eroded their valleys, showing these lands to have then stood far higher than now.

The Hudson River channel is traced somewhat more than a hundred miles out to sea, to a maximum depth of 2,844 feet. Similar depths are known by the United States Coast Survey and British Admiralty soundings, as Prof. J. W. Spencer has pointed out, for the former continuation of the Mississippi and St. Lawrence rivers and in the entrance of the Gulf of Maine, between Cape Cod and Nova Scotia. All about our northern and Arctic shores, from Maine around to Puget Sound, abundant fjords prove the land to have been formerly much elevated. On the coast of California, submarine valleys discovered by Professor George Davidson, of the U. S. Coast Survey, reach to depths of 2,000 to 3,120 feet; and Professor LeConte has shown that they are of late Tertiary and Quaternary age, probably contemporaneous with the submerged valleys of our Atlantic coast, and closely associated with the Glacial period. In the fluvial deposits of the Mississippi River, laid down while the ice-sheet was being formed, Professor E. W. Hilgard finds evidence that the interior of our continent northward, about the sources of the Mississippi, was then uplifted not less than 3,000 feet above its present height. Likewise the fjords of Scotland and its adjacent island groups, and especially the much deeper fjords of Scandinavia, prove for that glaciated region an altitude thousands of feet higher than now, the maximum depth of the Sogne fjord, the longest in Norway, being stated by Jamieson as 4,080 feet. In the same way, New Zealand and Patagonia, formerly glaciated, are remarkable for their abundant, long and branching fjords. But the most surprising known submerged continuation of any river valley is that of the Congo, which, according to Mr. J. Y. Buchanan, is determined, by soundings for a cable to connect commercial stations on the west African coast, to be about eighty miles long, descending to the profound depth of 6,000 feet below the sea level.

The Congo valley, only about four hundred miles south of the equator, proves that the epeirogenic uplifts, causing glaciation, were not limited to drift-bearing regions. Where the uplifted areas were in so high latitudes, both north and south, that their precipitation of moisture gave snowfall during all, or nearly all, the year, they began to be covered by snow, which became consolidated below into ice and grew in depth to hundreds and thousands of feet.

Why the earth during the Glacial period was extraordinarily deformed for comparatively short periods by great epeirogenic movements of elevation and correlative depression of other tracts, is a more fundamental and not less difficult question, for which I have attempted an answer in an appendix of Wright's "Ice Age in North America," ascribing these movements to stress stored up previous to its relief by the folding, overthrust and upheaval of mountain ranges. This explanation, although diverging widely from formerly assumed conditions of continental stability, seems yet well consistent with Dana's doctrine of the general permanence of the continents and oceanic basins.

NOTES ON THE DISTRIBUTION OF SOME OF THE CONIFERS OF NORTH-WESTERN CANADA.

BY J. B. TYRRELL, OF THE GEOLOGICAL SURVEY OF CANADA.

THE following observations on the limits of some forest trees were made while conducting geological surveys in the interior of northwestern Canada, in the country extending from Lake Winnipeg northwestward to the Athabasca River.

White Spruce (*Picea alba*) is the most important timber tree of this whole region. It occurs throughout the heavily wooded districts from Riding and Duck Mountains, in northern Manitoba, northwestward to the great forest region between the Saskatchewan and Churchill rivers, and thence westward beyond the Athabasca. North of the upper part of Churchill River it extends into the rocky granite country for a short distance and then disappears, so that its general northern limit is here reached at, or south of, the height of land; but while the writer was travelling across Little Hatchet Lake, in north latitude 58°40 and west longitude 103°45, a high sandy island was found on which was a small grove of tall white spruce, some trees with a diameter of fifteen inches. None others were seen anywhere in the vicinity. This grove, therefore, forms a little outlier in the surrounding scattered forest of small black spruce and Banksian pine, the hill of warm dry sand furnishing it with a sufficently congenial home. Extending in from the west the white spruce occurs on and around the shores of Lake Athabasca, but it does not appear to grow at any great distance back from the lake. Black Spruce (*Picea nigra*) is usually a smaller tree than the last, and is scattered on the low lands everywhere thoughout the forest regions of the Province of Manitoba, and the District of Saskatchewan, but north of the Churchill River, and south-east of Lake Athabasca it often ascends to the higher lands. Its northern limit for this region has not yet been traced. Balsam Fir (*Abies balsamea*) grows to a large size among the white spruce on the top and sides of the Duck Mountain in Manitoba, and between the Saskatchewan and Churchill rivers in the District of Saskatchewan. It extends for a short distance north of the Chuchill River, where it appears to reach its northern limit.

Tamarac (*Larix Americana*) is found growing on the low wet land from the northern edge of the prairie region, northward as far as Lake Athabasca, but its northern limit has not yet been reached.

Cedar (*Thuya occidentalis*) has its general northwestern limit east of Lake Winnipeg, but an isolated colony occurs on the high ridge between Winnipegosis and Cedar lakes, two hundred miles distant from the general limit. No trace of cedar could be found in the intermediate country.

Red Pine (*Pinus resinosa*) also has its general northwestern limit some distance east of Lake Winnipeg, but an outlying grove is said to occur on Black Island, a large sandy island in the lake. Cones collected from trees on this island, and undoubtedly belonging to this species, were sent to the writer by Mr. A. Neison, of Badthroat River.

Scrub Pine (*Pinus banksiana*) grows on the high stony morainic hills on the northeastern portion of Duck Mountain, and on the sandy ridges to the north.

From here it extends northward and northwestward, keeping north of the heavy white spruce forest. It is the principal tree in the rocky and sandy region from the Churchill River northward to Black River, where it grows to a height of from twenty to forty feet, and to a diameter of from eight to twelve inches. On the more level sandy plains it here forms typical pine barrens, the trees being thinly scattered over the surface, while the land beneath them is quite devoid of undergrowth and there is little or no fallen timber, so that the whole country has a park-like aspect. On the rocky slopes it has taken root in the niches and crevices, and is usually stunted and very irregular. It extends north of Black River and Lake Athabasca, and its northern limit has not yet been traced.

THE AFFINITIES OF BASQUE AND BERGER.

BY CANON ISAAC TAYLOR, M. A., LL. D., LITT. D., YORK, ENGLAND.

In the Transactions of the Berlin Academy for June, 1893, Professor Von der Gabelentz has published a paper in which he endeavors to establish a connection between Basque and the languages belonging to the Berber family of speech, such as Kabyle and Tuareg. He admits that the results of his comparison are small, the languages differing in structure of speech, in gender, and in most of the formatives. But he urges that they had certain analogous laws of phonetic change, and that there is a resemblance in a few culture words, mainly the names of animals and of articles of dress. The paper is one of the numerous examples of the way in which pure philologists may be led astray by want of an adequate acquaintance with anthropology. The author bases his attempt on a recent paper in *Ausland* on the craniological resemblance between the Berbers and the ancient Iberians. He then assumes that Basque represents the ancient Iberian speech, whereas Van Eys and Vinson, the two highest authorities, consider that it is impossible to explain such remains as we possess of the ancient Iberian by means of Basque. Broca, moreover, has proved that while the skulls of the Spanish Basques resemble, to some extent, those of the Iberians, the skulls of the French Basques belong to a different type. It is now believed that the race to which the French Basques belong imposed its language on the Spanish Basques, a feebler people of the Iberian type. If this is the case, the results obtained by Von der Gabelentz would be easy of explanation. A conquered people acquiring the language of their conquerors would retain their own phonetic tendencies, and at the same time would incorporate into the acquired language certain classes of words such as those which agree in Basque and Iberian, notably the names of articles of dress and of domesticated animals. In short, the ancient Iberian may have affected Basque much in the same way that Celtic has affected English and French. It has introduced sundry phonetic tendencies, and some loan words belonging to certain classes. Hence we may still hold fast to the old conclusion that the nearest affinities of Basque are with Accadian and the languages of the Ural-Altaic type.

LETTERS TO THE EDITOR.

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

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

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

The So-called Sand of Great Salt Lake.

The white deposit which covers Garfield Beach and the adjacent shore of Great Salt Lake, Utah, although commonly called sand, does not consist of true sand. An examination under a low magnifying power, such as that afforded by a common pocket lens, shows that all the particles, or grains composing this so-called sand are very smooth and shiny, many being globular, others ovoid, and others dumb-bell and club-like in form. None of them present angular or irregular surfaces, and none have sharp edges or points. When treated with hydrochloric or nitric acid this oölitic "sand" rapidly dissolves with energetic effervescence, leaving but tiny little specks of silicious matter behind, which latter form nuclei in the centre of the oölitic grains. The solution thus obtained contains lime. A very careful scrutiny under high microscopic powers shows the most of each grain to consist of a white, fibrous or somewhat crystallized mineral, with a central enclosed bit of dark gray mineral, that which is left as silicious undissolved matter after the acid treatment aforesaid. In fact I have found a few grains containing nuclei so large that they could be readily seen by the unaided eye. It appears, therefore, that each grain of this deposit is a nodule or concretion, consisting of white crystalline calcite, containing a minute bit of silica or silicious matter as a central nucleus around which the calcite has collected. Some months ago Professor Rompletz reported traces of what he regarded as an alga in oölitic sand from the shores of Great Salt Lake. But Dr. George Jennings Hinde, F. G. S., of London, who has made recent examinations of samples of this oölitic "sand," writes me that he has not discovered any evidence of organic orgin in it. In all other respects Dr. Hinde's observations seem to agree with those made by me during the past year.

Henry Montgomery.

University of Utah, Salt Lake City, July 31.

Nature's Rotation of Crops.

An open sandy field which the writer has passed several times a week, for the past ten years, has illustrated well this fact.

No record has been kept, but for the past five years, my recollection is accurate, and for a longer period, I am sure that the "crops" have been of the character stated, though the order of succession may not be strictly correct.

Seven or eight years ago there was a yield of *Œnothera biennis* which was phenomenal. The following year there was scarcely a plant of this species to be noticed, but a fine crop of mullein succeeded. Daisies followed the mullein, the next year daisies and golden rod (*S. nemoralis*). The year after the solidago took full possession and was a most magnificent crop. The year following but little golden rod could be seen, and very few daisies. Last year was the most magnificent crop of *Hypericum perforatum* I have ever seen. When in blossom, the field was one mass of solid color; it seemed the petals must touch each other over the whole surface of the entire field. It was a glory not to be forgotten. This year not a plant of the species is visible riding past. Scattered daisies, golden rod (not *S. nemoralis*), a few *Œ. biennis*, and an occasional lespedeza (*L. capitata*) are all that show. The ground is very sparsely covered, whereas last year it was completely occupied, as indeed also by the daisies, the œnothera, and the golden rod in their respective years.

I am satisfied the same thing takes place on other unoccupied sandy fields about here, but I have not watched them as closely nor as regularly as this one. M. W. V.

Fort Edward, N. Y., July 29.

Worms on the Brain of a Bird.

To judge from Professor French's communication under this title in the current volume of *Science*, p. 20, he is unacquainted with the description and figures of the thread-worm of the snake bird given by Prof. Jeffries Wyman, in 1868, in the Proceedings of the Boston Society of Natural History, Vol. 12, p. 100. Samuel H. Scudder.

A Space-relation of Numbers.

The recent notes and discussions as to certain curious relations observed by some persons between sensations of color and of sound,—relations hardly conceivable by others who, like myself, have never experienced them,—have led me to reflect upon a peculiar conception of my own, which may be called a space-relation of numbers. I have never heard it alluded to by any one; but it has been constant with me since childhood, and seems so peculiar and inexplicable that it may be worthy of mention and inquiry. It is presented, therefore, in the hope that the experience of others may throw some light upon it as a mental phenomenon, and help to show whether it be a mere idiosyncrasy or an experience at all known, and, if the latter, how far familiar, and with what, if any, modifications.

My first distinct recollection of this idea goes back to the age of nine or ten years, in connection with learning the multiplication table. This I was taught, not at school, but by home instruction, and without any use of cards, tables, slates, abaci, or any visible signs or aids whatever. It was purely abstract and *memoriter*. Somehow, then, and ever since, the numbers from 1 to 100 have been conceived of by me as holding, relatively, definite positions in space, from which they never vary,—the mention or use of the number being at once associated with its position relative to other numbers, in the same way that the mention of a well-known country or river brings up a mental picture of its geographical location.

This numerical position has no relation with that of any other object or thing, nor with the position of the body or the points of the compass. In describing it, however, I must employ the latter, but simply as aids, in place of a diagram. The numbers, which are conceived of merely as points or stations in space, appear to be arranged in a peculiar line or lines in a horizontal plane. Beginning with unity, the series runs in a straight line to 20, where it turns ninety degrees to the right, and so goes to 30. Using the points of the compass merely for the present description, as above stated, and not from any connection with the number-scheme itself,—if the series 1-20 runs (say) northward, 20-30 runs always east, 20 being the apex of the right angle. From 30 to 40 the course is *reversed* and runs back westward; at 40 it again turns at a right angle and proceeds south, without interruption, to 90, where the line again turns east from 90 to 100. Above this point, the numbers have the same positions again, and so in each succeeding hundred; so that the same description applies to all.

It will be seen by any one who attempts to put this scheme on paper, that, according to the arrangement, the numbers 30 to 40 would coincide, in reverse order, with 20-30, 40 falling upon the same spot as 20; while 40-60 would coincide with 1-20, in reverse order. But in the mental conception this is not the case. The line 30-40 seems parallel to 20-30, but at some little distance; and a vague sense of space, gradually increasing until no distinct relation is consciously noted, prevents any approach or interference between the numbers above 40 and those below 20. This fact confirms the impression that the idea is not due to any artificial aid in the way of diagram, table, or the like, in childhood.

The only suggestion that occurs is found in the fact that about that period the family had lived for some time in a large hotel (the Delavan, at Albany), whose corridors and numbered rooms may have impressed themselves on the child-mind in some such way. But I distinctly recall that certain of those rooms, occupied at different times by the family, did not at all have the positions that their numbers hold in this mental scheme.

Be this as it may, however, the clearness and the persistence of this association are remarkable, and I should be greatly interested to know if others can report any similar experience. If certain chords in music can suggest the sensation of purple, or the sound of a word a corresponding impression of blue, etc., as apparently is the case with some persons, why may not certain abstract numbers have similar associations of space-position?

D. S. Martin.

New York, Aug. 3.

Preliminary Note on the Cottony Scale of the Osage Orange.

In June I found a Cottony Scale (*Pulvinaria*) in some abundance on an osage-orange tree (*maclura*) in Las Cruces, N. Mex. The young were hatching on and about June 14th. This scale would be referred by modern entomologists to *Pulvinaria innumerabilis* (Rathvon) Putnam, but finding that it did not agree very well with published accounts of that species, I sent to Professor Bruner for specimens of the true insect, which abounds at Lincoln, Neb. Professor Bruner very kindly forwarded without delay a number of examples from box-elder, which were evidently not quite the same as my osage-orange scale.

The box-elder scale, however, agrees with *innumerabilis*, while the *maclura* scale is what was formerly named *macluræ*, and afterwards sunk as a synonym of *innumerabilis*.

The most conspicuous and constant difference is in the size. In order to show this, I boiled the adult females (which had formed ovisacs) in caustic soda, and spread their skins flat on a glass slide. Thus treated, the measurements were as follows:

P. maclurae (Las Cruces) . . length 10, breadth 10 mm.
P. innumerabilis (Lincoln) . . " 7½, " 5 "

It is thus seen that *maclurae* is both larger and broader in proportion; and no intermediate specimens were found. Another difference is in the length of the fourth joint of the antenna: in the Las Cruces *maclurae* it is about as long as the third joint, whereas in the Lincoln *innumerabilis* it is decidedly shorter than the third. I have not yet examined enough specimens to make sure if this character is invariable. I do not wish to assert positively that *L. maclurae* is a valid species, but its characters are such as have been held to distinguish species of *Pulvinaria* in Europe. I hope to set the matter at rest hereafter by the examination of more extensive material, but it must be admitted at least that it is a very distinct race or variety. In this we revert to the original opinion of Fitch, Walsh and Riley (1855, 1860, 1868), which has been set aside for so many years.

In order to be sure that I had rightly identified the two forms, I sent specimens to Professor Riley. He at once replied: "You are perfectly correct. A. [this refers to the lettering of the specimens] is the form which I described as *Pulvinaria maclurae,* while h. is identical with typical specimens of *Pulvinaria innumerabilis* on maple."

It appears that Robert Kennicott was the first to suggest the name *maclurae,* and Fitch to publish it. This was in the *Country Gentleman,* Jan. 18, 1855. In 1868 Messrs. Walsh and Riley published another description of the osage orange scale, also using the name *maclurae.* Those who do not consider the *Country Gentleman* a proper medium for scientific description may cite Walsh and Riley as nomenclators. If this should be done, it would seem that *innumerabilis* Rathv., published in the *Pennsylvania Farm Journal,* 1854, has at least no better standing, in which case Fitch's name *acericorticis,* given in the *Trans. N. Y. Agric. Society,* 1860, should be employed, or if it be insisted that the description must appear in a purely scientific publication, we must fall back on *acericola,* Walsh and Riley, 1868! For my own part, I would use the earliest name in each case, but one must allow that this is a matter for legitimate differences of opinion.

Thus we have—

(1.) *Pulvinaria innumerabilis,* Rathv., 1854. The Cottony Scale of the Maple.
= *acericorticis,* Fitch, 1860.
= *acericola,* W. & R., 1868.

(2.) *Pulvinaria maclurae,* Kenn. MS., Fitch, 1855. The Cottony Scale of the Osage Orange.
= *maclurae,* W. & R., 1868.

It need hardly be pointed out that the separation of these races or species is a matter of some interest to economic entomologists. T. D. A. Cockerell.

Las Cruces, N. Mex., July 29, 1893.

Explosive Gas in Hot Water Apparatus.

In the hot water apparatus, used in heating houses, it is well known that gas or "air" accumulates from time to time. This is let off from the radiators where it may collect by turning the "air" tap provided; otherwise the accumulation under ordinary circumstances would interfere with the circulation of water through the pipes. Being curious as to the nature of this gas, on a certain occasion I smelled it when escaping from the tap, and detected a peculiar odor of what I took to be a hydrocarbon compound. Collecting some of the gas, I cautiously applied a light to it, which produced an explosion.

The furnace was a small, upright one, with the water heated between its double walls, large enough to warm in winter time a house of seven or eight ordinary rooms. Anthracite coal was used.

With a larger upright furnace, having tubes for the smoke and heated gases to pass through in its upper part, in addition to the water-filled sides of the first, the amount of gas collecting in the highest radiator in the house was more abundant, especially when anthracite was used instead of bitumenous coal, for which the furnace was also adapted. As a matter of fact, several litres of gas were produced each week in two neighboring houses supplied with this latter style of furnace, during the period of observation,—a few weeks during last winter.

A considerable quantity of the gas was collected for demonstration before a popular meeting of the Institute of Science. Jars of various sizes were filled with the gas, which was burned under various conditions. 1st—The peculiar odor of the gas was tested. 2nd—It burned in the jars when inverted, and otherwise very much like pure hydrogen, giving forth very little light, but much heat. 3rd—The products of combustion showed no trace of carbonic dioxide which could be detected by the lime water test, which was sensitive enough to detect its presence in the room from the respiration of those present. From this it was inferred that neither carbon monoxide nor a hydrocarbon could be present in any considerable quantity. 4th—Pure nitrogen dioxide injected into the gas gave no ruddy discoloration. Hence, there was no oxygen in the gas. 5th—When mixed with air it would explode like air and hydrogen. 6th—It was not convenient at the time to apply any other tests, or any very accurate ones. The impression was formed that the gas must be nearly pure hydrogen.

If it was nearly pure hydrogen it must have come from the decomposition of the water, which would apparently imply a corresponding oxidation of the iron piping or of the heated iron in contact with the water within the furnace. The greater abundance of the gas when anthracite was used suggested that the origin of the gas was the rapid oxidation of the water tubing within the furnace when the heat was particularly intense. If so, every litre of hydrogen produced would mean the conversion of over one and a half grains of metallic iron into "rust."

Again, if a lighted match should be applied to the tap when this gas (pure) is being allowed to escape, the jet would catch fire and "roar" with a hot, bluish flame, of dimensions as terrific as the bore of the tap would allow. As by the "boiling over" of the furnace the small tank and upper coils under some conditions of water pressure may be emptied and filled with air, what would the consequences be were the mixed gases allowed to escape at night with a lamp held in the hand carelessly near such a jet?

The discussion of these demonstrations revealed the fact that no one present ever knew or heard that the gas escaping from radiators might be explosive—not even the builders, plumbers and founders.

Query 1. Is the formation of explosive gas within the hot water apparatus of our houses rare, peculiar to certain furnaces, or is it common?

Query 2. Has an accurate analysis of such gas been made; and if so, what are its constituents?

A. H. MacKay,

Halifax, N. S.

Mineral Wax.

In *Science* of July 14th, page 25, I notice an article on "Mineral Wax," from which the following is an extract: "In the United States it (mineral wax) is mined *in situ* at Soldiers' Summit, Uintah County, and in Emery County, Utah." Permit me to state that Soldiers' Summit of this Territory is in Utah County; that mineral wax or ozocerite is not mined at Soldiers' Summit, nor in Uintah County, nor in Emery County, Utah. I greatly regret to have thus to correct the writer of the aforesaid article, for it would be an especial pleasure to me to be able to report mines and mining of ozocerite from Utah. I think a small quantity of it occurs in Emery County. But it is not yet mined. Of course, it may occur in large quantity in Utah, but up to the present time no satisfactory evidence of such occurrence has been presented. It is, however, possible at present to report ample and satisfactory evidence of the occurrence in Utah of large quantities of three related hydro-carbons, viz.: *wurtzillite, uintahite* and *asphaltum.* Of these, the first has not yet been mined; but the second and third are being mined with some degree of activity.

Uintahite, often called Gilsonite, after a resident prospector and miner in this vicinity, yields black varnish. It is very light, being only a little heavier than water. Its color is black, and its streak is brown or reddish-brown. It possesses a brilliant, shiny lustre, and has a perfect conchoidal fracture, like that of glass, quartz and obsidian. In fact, it is not infrequently mistaken for black obsidian or volcanic glass, which also occurs in great quantity in this Territory. Uintahite is also very brittle. When heated it melts readily, but will not burn. This substance is hauled in wagons from the mines near Fort Duchesne, in Uintah County, to Pleasant Valley Junction, on the Rio Grand Western Railway, a distance of more than a hundred miles, to be shipped East for the manufacture of varnish.

Wurtzillite bears a remarkably close resemblance to uintahite. It has a similar color, lustre, fracture and specific gravity, and it is about equally brittle. But wurtzillite readily burns, yielding a bright light from the combustion of illuminating gases. Again, its streak is black, and it is slightly sectile, being capable of being cut or pared by a knife much as rubber or horn may be pared. Wurtzillite has been reported from Wasatch County, as well as from Emery and Uintah Counties, in considerable amount. Asphaltum occurs in Emery and San Pete Counties. It is somewhat mixed with sand and other impurities, but it is already being mined in considerable quantity for paving the streets of various Western cities.

In addition to wurtzillite, uintahite, asphaltum and ozocerite, other hydro-carbons are found in Utah; for example—albertite, petroleum and natural gas. But, as yet, none of the latter have been made productive.

HENRY MONTGOMERY.

University of Utah, Salt Lake City, July 29.

ANIMAL VOCABULARIES.

A GOOD deal has been said about the probable existence of definite vocabularies in the language of the lower animals, and I believe one has gone to Africa to study Simian speech. This is all well enough, but there is no need of going beyond the barn yard to hear a definite animal vocabulary of a considerable number of words. Hear the rooster's warning cry when he sees or hears indications of danger. It is a definite sound, and perfectly understood by every hen and chick. Drop food to the mother hen. She quickly inspects it, and if approved, tells the little ones to eat, by uttering her well known "Coot, coot, coot!" If she decides that it is not fit to eat, she as plainly tells them to let alone. The other day a green worm fell from a tree near a brood of chickens. Every chick ran to seize the morsel. The mother gave one quick glance at the insect and said, "*Skr-r-r-p!*" Every chick stopped instantly. But one wilful child, loth to believe his mother's assurance that it wasn't fit to eat, would make him sick, etc., started a second time to pick up the worm. "*Skr-r-r-p!*" commanded the hen sharply. Even the wilful child obeyed this time, and the whole brood walked off contentedly. Discuss as we will the particular reason for the hen's cackle before and after laying, the fact remains that it is a definite utterance, as plainly understood by both gallinæ and homines as any expression in human speech.

My horse has a low whinny which means "water," and a higher-keyed, more emphatic neigh means food. When I hear these sounds I know as definitely what she means as if she spoke in English. This morning, passing along the street, I heard that same low whinny and, looking up, saw a strange horse regarding me with a pleading look. I knew he was suffering from thirst, and no language could make it plainer.

The language of the lower animals is not all articulate. It is largely a sign language. The horse does a deal of talking by motions of the head and by his wonderfully expressive looks. He also, upon occasion, talks with the other extremity. A peculiar switch of the tail and a gesture, as if threatening to kick, are equine forms of speech. The darkey was not far wrong who said of the kicking mule, "It's just his way of talking!"

The dog can not only "look volumes," but can express whole sentences by wags of the tail more readily than can the waving flags of the signal corps. All that is necessary is to learn his code. We expect our domestic animals to learn our language, and punish them cruelly if they fail to both understand and obey our commands; yet, notwithstanding our higher intelligence, we fail to learn their language, by means of which we might better understand their wants and dispositions, and thus control them by kindness and sympathy, instead of by harsh and arbitrary treatment. I see horses passing along the street, which are saying by every look and motion that they are suffering acute torture from a too short check rein. Their drivers are often people who would be shocked if they could comprehend their own cruelty. But they do not understand horse language, and some of them do not seem to have horse sense.

The language of animals is a neglected subject. The facilities for its study are within the reach of all, and no previous preparation is required. The study can be pursued without interfering with other occupations, and even a little systematic observation will bring large returns in both pleasure and profit.

CHARLES B. PALMER.

Columbus, Ohio.

A MAYA MONTH-NAME—KHMERS.

IN *Science*, Aug 4, Professor Thomas gives a new name to the 17th month of the Maya calendar on the basis of a phonetic rendering of its symbol.

I do not intend to dispute the correctness of his rendering; I think it quite possible he is right; but I seriously question his inference, that, because the symbol reads *ak-yab*, that therefore was the month-name.

The work *kayab* is from the verbal stem *kay*, to sing or warble. As this concept cannot be objectively represented, the Mayas had recourse to a method very familiar with them, that of the rebus, to convey or keep in memory its approximate sounds. They chose to indicate the guttural initial *k* by a turtle, called in their tongue *ak*; prefixing it to the syllable *yab*.

This method of writing is what I have called "ikonomatic," and I have shown abundant instances of it in Mexico and Central America. (See my "Essays of an Americanist," pp. 213-229). Through neglecting to regard its principles, both Prof. Thomas and Dr. Seler have made several obvious errors in translating the Mexican and Maya codices, as I expect to show in a work I am preparing on the calendar system of those nations.

With regard to the origin of the Khmers and their ethnic affiliation, I do not think that Professor Keane's claim is relevant to that put forward by Dr. Maurel. The latter maintains that the Khmers belong to the "Aryan," in the sense of the "Sanscritic" peoples; and that they are in Cambodia an intrusive stock, arriving practically within historic times. I understand Professor Keane to differ with both these opinions.

D. G. BRINTON.

Media, Aug. 7.

THEORY OF COLOR SENSATION.

An objection to my theory of color-sensation (an abstract of which has lately appeared in *Science*) has been more than once made to me, which needs to be met, but which can be met very easily. It is that I suppose the three primary color-sensations to be conveyed to the brain by one and the same nerve, and hence that the theory is not consistent with the widely accepted doctrine of the specific energy of nerves,—the doctrine, namely, as applied to the eye, that we recognize two reds to be like sensations, not by any specific quality in the sensation, but by the fact that they affect the same set of nerves, and that if a pure blue light could by any possibility be made to cause these nerves to "vibrate" (to use the original Helmholtzian term) the sensation communicated to consciousness would still be red. But this doctrine, which has strong reasons in its favor, as regards the sense of hearing, had never much support in the sense of smell and taste, and has now been totally disproved for the sense of sight.

A few years ago Holmgren announced a remarkable discovery, and at the same time a remarkable confirmation of the original theory of Helmholtz. He caused a very minute image of a point of light to fall upon the retina, so minute as to be smaller in diameter than the diameter of the rods and cones. If this image was of white light, it felt to the observer sometimes red, sometimes green and sometimes blue, as it moved about the retina; if it was of yellow light, it looked sometimes red and sometimes green; and the primary colors were at times altogether invisible. If this observation had been confirmed by other investigators, it would have proved conclusively that each minutest fibre of the optic nerve responds only to a limited range of vibration-periods of light, and that, as Helmholtz at first was inclined to suppose (he says explicitly in the first edition of his *Physiological Optics* that the three effects *may* all be capable of being transmitted by a single nerve), three adjacent fibres must participate in conveying a sensation of grey to the brain. But this observation of Holmgren has *not* been confirmed. The experiments have been repeated by Hering with quite opposite results, and he has also detected the probable source of Holmgren's error; and Hering's results have been confirmed in Helmholtz's laboratory. Hering's paper on the subject was published in *Pfluger's Archiv* some four years ago; I am unable to look up the exact date, as the admirable free public library of Duluth as yet lacks scientific books of a non-popular character. In view of these experiments, no writer on physiological optics (not even Helmholtz) at present expresses himself in any other language than that which implies that all the physiological processes essential to the production of grey-sensations and of color sensations may go on in a single cone (if not in a single rod). C. L. FRANKLIN.

Duluth, Aug. 2, 1893.

CURRENT NOTES ON ANTHROPOLOGY.—NO. XXXII.

[*Edited by D. G. Brinton, M. D., LL. D., D. Sc.*]

RECENTLY PUBLISHED AMERICAN CODICES.

So rare are the documents which escaped the fanatic iconoclasm of the early missionaries, that it is a most agreeable duty to chronicle the discovery and publication of hitherto unknown Codices, or native manuscripts, of the Mexican and Central American peoples.

Last year, the American Philosophical Society published in admirable style the Codex Poinsett, the fragment of a pre-Columbian book relating to the collection of taxes in the ancient empire of Anahuac (a term entirely proper, in spite of Dr. Seler's onslaught upon it). Its name was given to it after Mr. Poinsett, formerly minister of the United States to Mexico, who brought it from that country and presented it to the Society, which has at considerable cost had it carefully chromo-lithographed and incorporated in its Transactions.

With not less praiseworthy zeal the Royal Library of Berlin has within the present year issued fac-similes of sixteen fragments of native Mexican MSS., brought from that country by Alexander von Humboldt, accompanying them with a small volume (pp. 136) of explanatory text from the pen of Dr. Seler, whose knowledge of the subject places him in the very front rank of Mexicanists. A few of these fragments, three or four of them, date anterior to the conquest; but the majority are subsequent to it, though none probably later than 1571. They are all of value in the study of the hieroglyphic script.

A third Codex of remarkable interest, and unquestionably ancient, has been published at Geneva by M. Henry de Saussure under the title of "Le Manuscrit du Cacique." It contains sixteen pages or plates, in colors, and tolerably well preserved. According to the statements about it, it is not of Nahuatl, but of Mistecan origin, which would increase its value, as this tribe is one of whom we have few monuments, though we know its culture ranked high, and dated from remote antiquity. It is said to contain the biography of a certain powerful Cacique, by name Sar Ho, whence the name given it.

The great libraries of our country should not delay to secure copies of these three ancient documents, as they are all published in limited editions, and they should be placed within reach of those in this country who devote some of their time to the fascinating problem of American hieroglyphic writing.

ETHNOLOGIC JURISPRUDENCE.

The first volume of a work, which will certainly be an epoch-making one, has appeared in Germany. It is Dr. Albert Hermann Post's "Grundriss der Ethnologischen Jurisprudenz" (A. Schwartz, Leipzig). It will be followed by a second volume, which will not be long delayed.

The author is already well known as a leading student in this department of ethnology, and also as a profound thinker on the fundamental problems of the social relations of man. In his present work he sets out in the first volume to exhibit all the primitive forms of law, custom and procedure, so that from them the fundamental and universal principles of the jurisprudence of all nations can be deduced. The second volume will indicate the development of these general principles in special fields of human law.

In this first volume, Dr. Post defines the elementary forms of the social organization as all reducible to four, the consanguine, the territorial, the feudal, and the social; or, the tribal, the communal, the regal and the democratic. Each of these has its own peculiar theory of what relates to ethics, rights and laws; and though in minor details there are constant and wide variations, each is controlled in its development by obedience to certain underlying principles, which place its moral and legal codes on diverse paths of development. They are in a measure historically sequent, the consanguine organization always being that of men in the lowest stages of culture, while the true social organization is as yet chiefly ideal, and may never be fully reached in practice.

The style of the author is terse and clear, and his reading is most extensive and accurate. The field he has chosen is a comparatively new one, and the results he has reached are in the highest degree of immediate and practical importance. It has been well said by Dr. Krauss, of Vienna, in a recent publication, that it would be a fortunate chance to substitute some of Dr. Post's reflections on the rights of humanity for the wholesale murder stories which stir the heart of youth in the school readers, under the name of patriotic wars.

THE STUDY OF PREHISTORIC ARCHÆOLOGY.

Now that archæology is recognized to be the only guide where history is silent, and often the more trustworthy guide where history talks a good deal, its systematic study should interest all who occupy themselves with questions of the higher education.

Dr. Hoernes, whose work on that branch has been already mentioned in these columns, contributes to the last number of the Zeitschrift für Ethnologie a scheme for the instructor, which is intended to present all the science in the most favorable manner for the student. It is as follows:

Explanatory.

Relations of prehistory to history and to anthropology, both physical and ethnological.

Systematic.

1. Introductory. History of the science. Sources of information, literary and monumental, with critical estimates of their values.
2. Methodical presentation. Geographical and ethnic divisions. Factors of evolution, as discovery, borrowing, alteration, descent. Special forms, as language, religion, law, family, government, clothing, food, ornament, commerce, etc.
3. Typological presentation. Models of workshops, houses, fortresses, altars, sepulchres; also weapons, tools, utensils, etc.; their use and development.
4. Historical presentation. First, with reference to natural history, the origin, races, varieties and migrations of men; second, cultural history, as the stone, bronze and iron ages; the palæolithic and neolithic periods; proto-historic culture; dawn of civilization, etc.

This scheme appears to offer a comprehensive plan for bringing the science before a class.

Migration of the Aztecs.

The Society of Geography and Statistics of the Republic of Mexico has just issued a second edition of a work by its first secretary, the licentiate Eustaquio Buelna, entitled "Peregrinacion de los Aztecas, y Nombres Geograficos Indigenas de Sinaloa."

The first edition was published in 1887, and received a certain measure of praise on account of the new material it offered concerning the tribes and languages of northwestern Mexico. This has been added to in the present edition, and in this respect it is welcome; but that the author has seen fit to expand and illustrate his theories on the pre-historic migrations of the Aztecs, is to be regretted, as he does but disseminate under the name of the society various exploded errors.

When, for instance, shall we hear the last of the "Atlantis?" Over and over again, its existence has been disproved, but it is ever rising in the minds of those who do not know what time o' day it is in science. How often must it be shown that the name "Atlantic" has nothing to do with "Aztlan" or "Aztalan," but is a Berber word meaning "mountain." Yet Buelna repeats and adopts these eighteenth century etymologies. Our faith in his acquirements in the Nahuatl language wanes considerably when we find him (p. 323) deriving the word *nahuatl* from *nahui*, four, and *atl*, water, for it is elementary that the terminal *tl* is dropped in composition. Of course, the "Toltecs" figure largely, although their existence as a nation has been disproved.

It cannot be said that Senor Buelna has approached this part of his subject with the requisite knowledge of its literature; and one cannot but regret that he seems unacquainted with the voluminous writings of Buschmann on the proper names and languages of Sinaloa and Sonora.

Note on Crotalus Adamanteus.

February 22, students while out collecting birds shot a diamond rattlesnake, *Crotalus adamanteus*, Beau., that measured five feet ten inches in length and nine inches around the thickest portion of the body. From the glossiness of the scales it is thought that it had recently moulted. There were only five rattles and a button present, which seems quite remarkable for such a long reptile. If I am not mistaken, such large animals of this species usually have more.

These animals, though once quite abundant, are becoming quite uncommon. The demand for their skins and rattles to make into Florida has done much to destroy this venomous animal. The skin is made into belts and neckties, while the rattles are used for sets on the ties and elsewhere. P. H. Rolfs.

Fla. Agr. Coll., Lake City, Fla.

BOOK-REVIEWS.

Le Lait par P. Langlois. Paris, Gauthier-Villars et Fils, Quai des Grands-Augustins, 55. 188p. 8°.

La Biere par L. Lindet. Paris, Gauthier-Villars et Fils, Quai des Grands-Augustins, 55. 206p. 8°.

The above treatise on Milk, by P. Langlois, Chief of the

Physiological Laboratory of the Faculty of Medicine of Paris, is divided into two parts—the first treating the subject theoretically, the second from the technical standpoint. Beginning with a chapter on chemical composition, the author proceeds with a discussion of the phenomena of coagulation, of milk secretion, and of the varying composition of different milks. A chapter each is devoted to woman's milk and to cow's milk, while others treat of the digestibility of milk, infant alimentation, and milk micro-organisms. The technical portion treats of milk analysis and adulteration. Under the first head is given in detail the admirable method used at the Municipal Laboratory of Paris, as well as the methods of Grandeau, Quesneville, and Adams. The various rapid methods are discussed in detail, and excellent means for the preservation of milk suggested. The book is new and a welcome addition to our literature on the subject.

Dr. L. Lindet, in his work on Beer, has produced a manual valuable to all interested in Brewing, either as a scientific study or from the purely technical view. The last half of the book is devoted to the practical process of brewing, following in main the procedure adopted in France, the limitations of the book preventing a more general discussion. The first part, however, is of wide interest, treating in an attractive and scientific manner Barley, Malt, Yeast and Hops, of the processes of saccharification, and of alcoholic fermentation. A shorter preliminary chapter touches upon the legislation and statistics regarding beer. The book does not impress one as a mere compilation from more exhaustive authors, but is distinctly a treatise upon the state of the science at the present hour, and is a most convenient book for reference.

These volumes form part of the Encyclopédie Scientifique des Aide-Mémoire, published under the direction of M. H. Léauté, Member of the Institute of France. This publication, which is distinguished by its practical character, is moreover scientific in its accuracy and in the authorative names which appear upon the title pages. When complete (it has been published at the rate of thirty or forty volumes a year since Feb., 1892,) there will be about 300 volumes uniform in binding and embracing the entire domain of applied science; Mechanics, Electricity, Engineering, Physics, Chemistry, Agriculture, Biology, Medicine, Surgery and Hygiene. In each case the most competent men have been selected to treat of their respective specialties, and while within the limits of an octavo volume of 200 pages it is necessary to leave out much of interest, still the authors of those works which it has been my pleasure to read have accomplished much in their difficult condensation, treating of their subjects in a fluent manner and omitting nothing essential. Each volume is terminated with a bibliography which enables the reader to pursue to its source any particular line of study.

C. P.

—The American Book Company have just issued a revised edition of William Swinton's "School History of the United States," the first edition of which appeared some twenty years ago. As the author is now dead, the revision of the work has been done by the editorial department of the Company, and the history has been continued to the present time. The book is well printed, and contains many maps and illustrations. Another book from the same house is a series of "Exercises in Greek Prose Composition," based on the first four books of the Anabasis and prepared by William R. Harper, President of the University of Chicago, and Clarence F. Castle, assistant professor of Greek in the same institution. The Company have also issued two volumes of their "English Classics for Schools," one of them containing three of Emerson's essays, and the other being an edition of Matthew Arnold's "Sohrab and Rustum," with an introduction giving a sketch of his life and writings and some other matter useful to the student.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

I wish to exchange a New Model Hall Typewriter, price $30, for a Daylight Kodak, 4x5 preferred. George A. Coleman, Dep't. Agric., Div. of Ornithology, Washington, D. C.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St., Newark, N. J.

A complete set of Bulletins of U. S. Geological Survey, various reports and bulletins of surveys of Missouri, Arkansas, Minnesota, Alabama, Illinois, New York, Pennsylvania, Indiana, Ohio and Texas; iron ores of Minnesota; Wailes' Agriculture and Geology of Mississippi (rare). To exchange for periodicals and books on Entomology or for Lepidoptera. Rev. John Davis, the Deanery, Little Rock, Ark.

For sale or exchange.—A complete set of the report of the last Geological Survey of Wisconsin. T. C. Chamberlin, geologist. It consists of four large volumes, finely illustrated, and upwards of forty large maps and charts. Will sell for cash or exchange for a microscope. Address Geo. Beck, Platteville, Wis.

I have a fire-proof safe, weight 1,150 pounds which I will sell cheap or exchange for a gasoline engine or some other things that may happen to suit. The safe is nearly new, used a short time only. Make offers. A. Lagerstrom, Cannon Falls, Minn., Box 857.

Wants.

WANTED.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

DRAFTSMEN WANTED.—The Civil Service Commission will hold examinations on August 15 to fill two vacancies in the War Department; one in the position of architectual draftsman, salary $1,400, the other in the position of assistant draftsman, Quartermaster General's office, salary $1,200. The subjects of the architectural draftsman examination are letter-writing, designing specifications and mensuration, and knowledge of materials; of the assistant draftsman examination they are letter-writing, tracing, topographic drawing and projections. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

A YOUNG man who has been through the course in mathematics in Princeton University, wishes some tutoring this summer. Rates reasonable. Address P. H. Westcott, Cramer's Hill, Camden Co., N. J.

A GRADUATE of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

SCIENCE

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SCIENCE

NEW YORK, AUGUST 18, 1893.

BOTANY IN JAMAICA.

BY JAMES ELLIS HUMPHREYS.

We are apt to think, when speaking of American botany and botanists, only of those of the United States and Canada, assuming that our southern neighbors, both continental and insular, have not yet reached that stage of civilization that encourages the cultivation of the sciences. And so far as those regions are concerned which have felt the influence chiefly of Latin civilization, this is measurably true. But some of the neighboring islands have been under Anglo-Saxon rule for two centuries or more, and have felt different influences. Not, indeed, that their people, as a class, have been much affected by contact with their rulers, but in the British islands the mother country has especially fostered botanical study from an early time, and British residents have carried with them the scientific impulse.

Jamaica has been a British colony for fully two hundred years, and it is now more than one hundred since its first botanic garden was established at Bath. At first privately supported, it afterward received spasmodic government support. But eventually the site was abandoned and a new location was chosen beside the Wag water and among the beautiful hills of the interior nineteen miles north of Kingston. From this time the support of the government was constant and effective, and the Castleton garden grew steadily in consequence, under competent directors sent out from England. It has now an especially notable collection of palms and orchids, besides its economic collection.

Meantime the Hope Gardens, near Gordon Town, and six miles from Kingston, begun for private pleasure when the island was in the full tide of its prosperity from the profits of sugar and rum, have been taken up by the government and are destined to be the chief botanical centre of the island. This collection is newer than that at Castleton and therefore does not possess as many fine specimens and, in some other respects, does not equal it. But most of the propagating and active work of the department is now done at the Hope Gardens. As must inevitably be the case with most government establishments, the chief work of the Botanical department of Jamaica, as of other British colonies, is economic, the study of the useful plants of the colony, their propagation and products. Its work is at present ably directed by Mr. William Fawcett, F. L. S., formerly of the British Museum.

A third establishment in charge of the department is the experimental *Cinchona* plantation far up the Blue Mountains. Here, also, is the official residence of the Director, in an almost ideal location and climate. Indeed, it is said, to quite justify the enthusiasm of an admirer, who called it "the loveliest spot in the British empire."

This place, called Cinchona, can be reached only by a narrow bridle-path that runs twelve miles upward into the heart of the mountains from Gordon Town.

The department issues a periodical bulletin of the results of its work.

Ever since the time of Patrick Bowne and Sir Hans Sloane, the higher plants of the island have found devoted students. And among them must be specially mentioned Grisebach, whose "Flora of the British West Indies," London, 1863, remains the only hand-book of the subject. But the Thallophytes of the region have received little attention and offer a very attractive field.

The wife of the present energetic governor of the island, Sir Henry Blake, some time since proposed the raising of a fund to establish a permanent marine biological laboratory as a memorial to Columbus, who landed on the island on his second voyage. The idea is an admirable one, but the project remains, so far as can be learned, *in statu quo.* A small and well-equipped laboratory at a suitable point on the island, open to the zoölogists and botanists of the world, might be of the greatest service in affording means for the collection and preservation of the numberless tropical forms of life in which Jamaica and the surrounding waters abound. A party of zoölogists from the Johns Hopkins University has this year, for the second time, established a temporary laboratory at Port Henderson on Kingston harbor; but I understand that this choice of a location has been largely governed by the presence of suitable accommodations. It will be agreed that, in determining the site for a permanent laboratory, the abundance of available vegetable, as well as animal, life should be consulted. After a somewhat careful examination of the marine flora of the easterly part of the island, as far west as St. Ann's Bay, the writer can say that several of the ports on the north side are far more favorable, botanically, than Kingston harbor. And perhaps no region is, on the whole, more favorably situated or richer in its vegetation than the neighborhood of Port Antonio. This port has more frequent communication with the United States than even Kingston, from its extensive fruit trade. And the journey from Europe to Jamaica is less monotonous and less expensive, as well as quite as quick, *via* the United States, as by the Royal Mail from England.

Another factor of considerable importance lies in the much cooler and more healthful climate of the north side of the island, as compared with the south side.

In Jamaica, then, the botanist finds evidences of past and present activity in certain lines, and the sympathy and aid of fellow workers. It is much to be hoped that he may soon be able to find, also, the laboratory facilities, which will enable him to study to the best advantage the unsolved problems of tropical vegetation.

INTRODUCTION OF WEEDS IN GRASS SEED.

BY THOMAS A. WILLIAMS, STATE AGR'L COLLEGE, BROOKINGS, S. D.

In the course of some experiments on forage plants, which were begun last season on the Station grounds, quite a large quantity of grass and clover seed was purchased from various seedsmen, principally from Hendersons, of New York. At the time of sowing some of the packages were found to contain more or less seed of various weedy plants. The plots were watched closely, and the following plants were found to have been introduced:

Cruciferae.—Nasturtium palustre, (L.) D. C.; Sisymbrium officinale, (L.) Scop; Camelina sativa, (L.) Crantz; Brassica arvensis (L.) B. S. P.; Brassica alba, (L.) Gray; Brassica nigra, (L.)Koch; Brassica campestris, L.; Erysimum cheiranthoides, L.; Erysimum orientale (?) L.; Diplotaxis tenuifolia (?) (L.) D. C.; Raphanus raphanistrum, L.; Raphanus sativus, L.

Capparideae.—Cleome integrifolia, Torr. and Gray.

Violarieae.—Viola tricolor, L.

Caryophylleae.—Saponaria officinalis, L.; Saponaria vaccària, L.; Silene antirrhina, L.; Silene noctiflora, L.; Lychnis alba, Mill; Agrostemma githago, L.; Cerastium arvense, L.; Stellaria media, (L.) Smith; Spergula arvensis, L.

Geraniaceae.—Geranium pusillum, L.; Erodium cicutarium, (L.) L'Her.

Leguminosae.—Vicia sativa, (L.) Koch.

Umbilliferae.—Carum carui, L.; Coriandriem sativum, L.; Daucus carota, L.

Rubiaceae.—Galium sp. ?; Galium tricorne, With.; Galium verum, L.

Compositae.—Anthernis cotula, L.; Achillea millefolium, L.; Carduus nutans, L.; Centaurea cyanus, L,; Taraxacum officinale, Web.; Sonchus arvensis, L.; Sonchus asper, Vill; Sonchus olenaceus, L.

Borragineae.—Lithospermum arvense, L.

Plantagineae.—Plantago lanceolata, L.

Polygonaceae.—Rumex crispus, L.; Rumex acetosella, L.; Rumex acetosa, L.

Gramineae.—Panicum crus galli, L.; Panicum glabrum, (Schrad,) Gaud; Panicum sanguinale, L.; Avena fatua, L.; Eragrostis, major, Host; Eragrostis pilosa, (L.) Beauv; Bromus mollis, L.

It is interesting to note the spread of weeds in a new State. *Saponaria vaccaria* is found along the railroads, together with *Anthemis cotula*, over the whole of eastern South Dakota. The former has even followed up the freighting trails over the range between Pierre and the Black Hills, where it is quite common, particularly at watering and camping places. Man is evidently the one who is responsible for the distribution of this weed.

PERIODICAL CICADA.

BY C. V. RILEY, UNITED STATES DEPARTMENT OF AGRICULTURE, DIVISION OF ENTOMOLOGY, WASHINGTON, D. C.

DURING the present year two broods of the Periodical Cicada, or so-called "Seventeen-year Locust" (*Cicada septendecim* L.), one of the seventeen-year (*septendecim*) race, and one of the thirteen-year (*tredecim*) race, will make their appearance in different parts of the country.

The following list of localities has been prepared from previous records. Any evidence giving the extent of territory over which they appear in any county or state, or any well-attested dates of their appearance in previous years, will be thankfully received and appreciated.

BROOD XVI.—Tredecim—(1880, 1893.) Alabama—Lowndes County. Georgia—Cobb and Cherokee Counties. Tennessee—Lincoln County. North Carolina—Lincoln and Moore Counties. This brood is but little known, and all localities require further confirmation this year.

BROOD XI.—Septendecim—(1876, 1893). North Carolina—From Raleigh, Wake County, to the northern line of the State; also in the counties of Rowan, Davie, Cabarrus and Iredell. Virginia—From Petersburg, Dinwiddie County, to the northern line of the State; Bedford and Rockbridge Counties; Valley of Virginia, from the Potomac River to the Tennessee and North Carolina lines. District of Columbia—Woods north of Washington. Maryland—Southern half of St. Mary's County. Kentucky—Trimble County. Indiana—Knox, Sullivan and Posey Counties. Illinois—Madison County. Kansas—Dickinson and Leavenworth Counties. Colorado—Cheyenne Canyon. This is a well-established brood, most of the localities in the Eastern States, as well as those in Indiana and Illinois, having been verified in past years; but the localities in Kentucky and Kansas require confirmation, and that in Colorado is extremely doubtful.

NOTES AND NEWS.

IN this age of rapid advancement in all lines of knowledge, especially in science, people have learned that combined organized labor accomplishes far more exact results than individual effort. Every department of science has its organization for the promotion of that science. Such an organization is the Wilson Ornithological chapter of the Agassiz Association, for the promotion of American ornithology. It is composed of active, associate and honorary members. It is in no respect a rival of the American Ornithologists' Union, but has its work conducted on a coöperative plan, and therefore necessarily largely systematic. While furnishing the more advanced with ample material for work, it also offers such opportunities to the younger and less experienced as are best suited to their needs. It seeks to educate those just beginning and those pursuing a dilatory course into the highest usefulness as working ornithologists. Active members pay an initiation fee and a yearly assessment of $1.00, and are limited to 100 in number. This number is now nearly reached. Associate members pay a yearly assessment of 50 cents and are unlimited in number. All working ornithologists are invited to join and aid in the work. Applications for membership should reach the President or Secretary before Sept. 20, to insure insertion in the list of candidates for the October election. Address either Willard N. Clute, Sec., Binghampton, N. Y., or Lynds Jones, Oberlin, Ohio.

—William Beverley Harison published on the 15th "The Foreigner's Manual of English." This is prepared for use in mixed classes of foreigners, and can be used without any knowledge of the several languages, as English only is used throughout. It has been carefully corrected to embody all of the suggestions of Gouin, whose book appeared after completion of first MS., and during revision the MS. has been successfully used in teaching Chinese, Polish Jews and others absolutely ignorant of both written or spoken English. The lessons are arranged to give in each a concrete subject, and a useful vocabulary is given to enable the student to talk from the beginning.

—The Chain Hardy & Company, Denver, Colo., have just ready the revised and enlarged edition of the "Geology of Colorado and Western Ore Deposits." This work of Professor Lakes, of the State School of Mines, has already run through one edition as applied to Colorado. Now that the Western States have been included the sale is expected to be quite extended. The plates illustrating the geological formations are very elaborate, and illustrate the peculiarities of veins and ore deposits. The book is designed for a text-book, and is also adapted for general reading by those interested in mining.

—Rand, McNally & Co. have in preparation the Proceedings of the Bankers' and Financiers' Congress held in Chicago from June 19 to 24.

—The Scientific Publishing Co. have just ready a work on "Universal Bimetallism and an international monetary clearing house, together with a record of the world's money statistics of gold and silver," etc., by Richard P. Rothwell, editor of the *Engineering and Mining Journal*.

—Macmillan & Co. have just ready "A Treatise on the Theory of Functions," by Prof. James Harkness, of Bryn Mawr College.

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THE ATMOSPHERE OF STELLAR SPACE.

BY G. D. LIVEING, CAMBRIDGE, ENGLAND.

IT was an interesting speculation that Sir R. Ball opened up in this journal, a short time since, with regard to the lunar atmosphere. His argument might easily be carried further, and would take us, as I shall try to show, into the realms of stellar space. It has been objected to his theory that the velocity of the particles of air at ordinary temperatures, though on the average about five hundred yards per second, is not enough to carry a particle so quickly away from the moon that it would not be drawn back again by its gravitation. This objection vanishes if we consider, not the average velocity, but the velocities of individual particles, and the changes those velocities rapidly undergo in consequence of frequent collisions among the particles. It is not easy to grasp the numbers involved in my argument, but I will state them on the authority of Lord Kelvin's popular lecture on the size of atoms. He gives the number of particles in one cubic centimetre, or one-sixteenth of a cubic inch, of atmospheric air at ordinary barometric pressure and at ordinary temperature, as not less than a million million of millions, or 10^{18}. Maxwell, in his article on "Atoms," in the Encyclopædia Britannica, makes the number greater. These particles cannot move far, not more on the average than about one hundredth of a thousandth of a centimetre, without encountering one another, so that each particle collides with one or another of its neighbors no less than five thousand million times in every second. If we suppose the density of the moon's atmosphere to be only a millionth of that of our atmosphere at the earth's surface, there will still be at least a million millions of particles in one cubic centimetre of it, and the frequency of their encounters with each other will still be some thousands per second for each of them. These encounters will cause them to be perpetually changing their velocities, and while some will have, at any given instant, velocities many times greater than the average, others will move at correspondingly slower rates. The directions, also, of their movements will be constantly changing from the same cause. If we suppose two particles, moving with equal velocities in directions at right angles to one another, to come into direct collision, one of them will have its velocity increased in the ratio of the square root of two to one, or rather more than seven to five, while the other will be reduced to momentary rest. If, now, the former come into a similar collision with a third particle, one of these two will acquire a still greater velocity. And considering the prodigious number of the particles and the short distance they can move without encountering others, it is evident that there must be an immense variety of rates of motion amongst them, and many of them must have velocities far exceeding that necessary to carry them clear away from the moon, or the earth, or even from the sun. In fact, amongst so many millions of millions the chance that some one will go on increasing its velocity at every one of a large number of successive encounters is very great indeed, practically a certainty. If this be granted, some, if it be but a small fraction of the whole, will be always escaping from the outer surface of the lunar atmosphere into the planetary space; and the like must go on from the atmospheres of other planets, only the fraction of the whole which get clear away from the bigger planets will be so much less because of the greater attraction of the bigger masses.

One interesting consequence of this escape of only the quicker moving particles, is that the temperature of interplanetary space must be thereby raised above that of the outer regions of a planet's atmosphere. For the temperature is directly proportional to the average square of the velocities of the particles, and as only the quickest fly off for good, the average velocity of the remainder must be less than that of those that break away. The process of dissipating an atmosphere into space might be stopped by its own cooling effect. But it is obvious that there is another cause which prevents anything like this. The planets are continually sweeping through the interplanetary space where the escaped particles are moving about, and even if the density of this interplanetary atmosphere be only a millionth of a millionth of the density of that at the earth's surface, still there will be at least a million particles in each cubic centimetre, and some of them will get swept up by the planets in their course and will not get away again. Hence the process of dissipation will cease when a planet picks up in its course through space just as many as it loses by diffusion in the same time. It follows from this that there must exist in planetary space an atmosphere, greatly reduced in density, it is true, but of the same chemical constitution as the earth's atmosphere. That is to say, the chemical constituents will be the same, though not quite in the same proportions. For the average velocity of the particles of nitrogen is a trifle greater than that of the particles of oxygen, and so the former will escape into space rather more frequently in proportion to their numbers than the latter. Besides, the effect of gravity is to increase very slightly the proportion of oxygen to nitrogen in the lower strata of the atmosphere. Hence, for both reasons, the atmosphere of planetary space will be a trifle richer in nitrogen than the air we breathe. There is so very little free hydrogen in our atmosphere that we cannot detect it, but for all that, it is most probable that there is a very little. And as oxygen particles are sixteen times as heavy as those of hydrogen, the proportion of free hydrogen to the other gases will be proportionally greater in the upper regions of the air than in the lower; and since hydrogen particles move four times as quickly as oxygen particles, it follows that the former will escape from the earth's attraction about four times as fast, and so the proportion of hydrogen in planetary space may be sensibly greater than in air we are able to test. A similar argument will apply to particles of water vapor, which are little more than half as massive as particles of oxygen. If all the planets are thus losing continually some of their atmospheres and picking up an equal amount from the space they move in, it follows that all the planets must have atmospheres of similar constitution to our own. For each planet has for ages been losing some of its own and acquiring some of the air of other planets, and if there had ever been any difference, which is unlikely, considering the general unity of the solar system, it must long ago have disappeared in consequence of this interchange.

The argument is strengthened by what we know of the atmospheres of the planets, especially of our nearest neighbors, Mars and Venus. Not only do these planets give plain indications of their atmospheres, but it is certain that they are very much like our own. That is found out in the following way: Amongst the many dark lines, Fraunhofer lines, as they are called, in the solar spectrum there are certain well marked groups which Sir D. Brewster long ago pointed out to be due to the absorption of rays by our atmosphere, because they are seen to be blacker and more intense when the sun is low than when he is high in the sky. That is because the rays have to pass through a greater thickness of air before they reach us when the sun is nearer the horizon. Now, by carefully observing the light reflected from Venus and Mars, which must have twice passed through so much of their atmospheres as lies above the reflecting surface, it has been found that precisely the same rays which are darker when the sun is low are also darker in the spectra of these planets. Moreover, in these planets there are no new dark lines indicating any absorbent of a different kind. The more distant planets show additional absorption bands, but their atmospheres must, on account of their greater masses, perhaps also from lower temperature, be denser, and besides they appear to be full of clouds which may not be merely water-dust, and may well produce their own absorptive effects.

The argument, however, reaches a good deal farther. Not only are the planets moving through the so-called planetary space, but the sun and all its train are moving through the interstellar space. Astronomers are agreed that we are moving, but the direction of the movement is much better known than the pace. The rate is sometimes set down at about thirty miles a second: certainly not an extravagant estimate. But at any rate we are going, and leaving the interplanetary atmosphere, or some of it, behind. Even if the solar system had no such motion, the process of diffusion must gradually carry the interplanetary atmosphere into regions beyond, and, unless this diffusion were compensated by accession of air from without, the planets must gradually lose their atmospheres until the loss was stopped by the cooling effect before mentioned. After countless ages we have manifestly not reached that stage, so we must conclude that interstellar space is pervaded by an atmosphere, though it be of very great tenuity.

If this atmosphere is not of similar chemical constitution to our own, ours must be changing by slow degrees, and in course of ages the change must tell. There is, however, no reason to think that our atmosphere has for millions of years undergone any change sufficient to affect the constitution of animal life of the higher types, and if that be so the air of stellar space must be much the same as that of interplanetary space and our own. Sterry Hunt, from the preponderance of vegetable growth at certain periods of the earth's history, inferred that at those periods there must have been an excessive quantity of carbonic acid in the atmosphere; and he fancied that this was acquired from the stellar space as the solar system made its way into regions where there was an unusual amount of carbonic acid. Spectrum analysis has not led us to think that the chemical elements of the stars of any region are different from those with which we are acquainted in the earth and in the sun. Stars in the same region are mostly of the same type, and the types are few, and all the common types of spectra of stars give indications of elements which we know, and no certainty of any other elements. Distance makes no difference at all. The few stars with unusual spectra do not so much seem to have peculiar elements as to be in peculiar physical states. The universe seems, so far, of one make, and there are no facts which negative the supposition that the whole vast space through which we see stars is filled with air; air very rare indeed, perhaps not a millionth of a millionth as dense as ours, but still, on the whole, similarly constituted.

FISH ACCLIMATIZATION ON THE PACIFIC COAST.

BY HUGH M. SMITH, M. D., UNITED STATES FISH COMMISSION.

Few experiments in fish culture have been economically more important and successful than those which have been conducted by the United States Fish Commission with reference to the Pacific Coast. Coincident with the propagation of native fishes the introduction of non-indigenous species has been undertaken, with results that have been extremely gratifying to fish culturists, and perhaps more striking than any previously obtained in this or any other country.

Among the fishes inhabiting the rivers and coast waters of the Atlantic slope, none is better known, more important, and more highly esteemed than the shad (*Clupea sapidissima*) and the striped bass or rockfish (*Roccus lineatus*), the former being a food fish, pure and simple, the latter combining a gamey disposition with excellent food qualities. These fish are anadromous, entering the fresh water for the purpose of spawning and passing a large part of the year at sea or in the salt water. Attention will be called to the experimental introduction of these fishes to the west coast, although several other important food-fish, among them the black bass (*Micropterus salmoides*) and catfish (*Ameiurus nebulosus*) might also be mentioned in this connection.

The introduction of shad fry to the west coast was first undertaken as long ago as 1871, when 12,000 young fish were deposited in the Sacramento River, under the auspices of the California Fish Commission. After that the experiment was taken up by the U. S. Fish Commission and carried on until 1886, during which time 609,000 young shad were placed in the Sacramento River, 600,000 in the Willamette River, 300,000 in the Columbia River and 10,000 in the Snake River.

Two or three years after the first fish were planted a few more or less mature examples were obtained in the Sacramento River; as additional deposits were made, the number of marketable fish began to increase, and the fish gradually distributed themselves along the entire coast of the United States north of Monterey Bay, until finally they have come to rank next to salmon in abundance among the river fishes of the west coast.

The U. S. Commissioner of Fish and Fisheries, in his annual report for 1887, speaking of the small plants of shad fry made in the Sacramento River at Tehama, says:

"From these slender colonies, aggregating less than one per cent of the number now annually planted in our Atlantic slope rivers, the shad have multiplied and distributed themselves along 2,000 miles of coast from the Golden Gate of California to Vancouver Island in British Columbia. They are abundant in some of the rivers, common in most of them, and occasional ones may be found everywhere in the estuaries and bays of this long coast line.

"Prior to our experiments on the west coast it was a dictum of fish culture that fish planted in a river would return to it when mature for the purpose of spawning. The result of these experiments has been to demonstrate that this instinct of nativity, should it really exist, is in this case dominated by other influences, which have dispersed the shad planted in the Sacramento widely beyond the limits which we had assigned to them, and in the most unexpected direction.

"The cause is probably to be sought in the genial influences of the Japan current, which brings the warmth of equatorial Asia to temper the extremes of Arctic climate on the southern shore of the Alaskan Peninsula, and thence sweeping to the south, carries tropical heats to the latitude of San Francisco. Repelled on the one hand by the low temperature of the great rivers and fringe of coast waters, and solicited on the other by the equable and higher temperature of the Japan current, the shad have become true nomads, and have broken the bounds of the hydrographic area to which we had supposed they would be restricted. Following the track of the Asiatic current, and finding more congenial temperatures as they progress, it is not unreasonable to expect that some colonies will eventually reach the coast of Asia and establish themselves in its great rivers."

Shad are now found in greatest numbers in the Sacramento and Columbia Rivers, where they are of considerable economic value. Owing to the fact that very little apparatus specially adapted to their capture is employed, no correct idea of their actual abundance in a given stream can be formed. Nearly all the shad thus far taken have been obtained in nets operated for salmon or other fish, shad being only an incidental element in the catch. The price received by the fishermen is a good criterion of the abundance of the fish. When first taken, shad brought as much as $1.20 a pound; in 1892 the value in many places was only two cents a pound, and in the Columbia River at one period the catch was so large and the price so low that the fishermen did not go to the trouble of marketing the fish caught. The average price on the coast has declined in the past four years from ten cents per pound in 1889 to four cents in 1892.

An inquiry conducted by the U. S. Fish Commission in 1892 placed that bureau in possession of information showing the extent of the shad fishery in every river of the Pacific States. It was ascertained that in the year named 660,000 pounds of shad were marketed, the value of the same to the fishermen being about $27,000. Reports received during the present year indicate a catch of perhaps a million pounds, and it seems reasonable to anticipate a steady increase in the production with the improved facilities for shipment and the growing demand for fresh fish in the rising towns adjacent to the coast rivers. A careful estimate places the total value of the shad catch on the Pacific coast to date at $145,000, representing over 3,000,000 pounds, while the aggregate outlay for all purposes connected with the introduction of the fry was less than $4,000. This is certainly a satisfactory investment of the people's money.

The absence of a special scientific inquiry precludes the possibility of chronicling the changes which have probably been wrought in the habits of the shad as a result of the changed physical surroundings, thermic conditions, enemies and food supply. It may be noted, however, that the characteristic habit on the east coast of periodically ascending the rivers for the purpose of spawning and of returning, after the completion of that process, to the open sea where the principal part of the life of the fish is spent, appears to be considerably modified, in California, at least, where, in certain bays and estuaries, the shad is found in greater or less abundance during every month in the year. The evidence at hand indicates a condition prevailing in the littoral and fluvial waters of the Pacific coast that is very favorable to the growth of the shad. It is not unusual to take examples considerably larger than any ever seen in the eastern rivers. The average weight of the shad caught on the Atlantic coast is under four pounds, and the capture of fish weighing seven, eight or nine pounds is extremely rare. In California, however, it is not uncommon to secure shad weighing eight or ten pounds and reports have been made that fifteen-pound individuals have occasionally been obtained in salmon nets.

Of scarcely less consequence than the actual results of shad introduction on the west coast is the important bearing which the success of the experiment must have in determining the outcome of artificial propagation in regions in which it is not possible to distinguish with satisfactory accuracy the natural from the artificial conditions. If these far-reaching, and no doubt permanent, results attend the planting, on few occasions, of small numbers of fry in waters to which the fish are not indigenous, is it not permissible to assume that much more striking consequences must follow the planting of enormous quantities of fry, year after year, in native waters? There is no reasonable doubt that the perpetuation of the extensive shad fisheries in most of the rivers of the Atlantic coast has been accomplished entirely by artificial propagation. On no other supposition can the maintenance and increase of the supply be accounted for.

The introduction of the striped bass was accomplished in 1879, when about 150 fish a few inches long, taken in Shrewsbury River, N. J., were successfully carried across the continent and deposited at the mouth of the Sacramento River by an agent of the U. S. Fish Commission co-operating with the California Commission. Six or seven months later an example eight inches in length was reported from Monterey Bay, one hundred miles south of the locality where planted, and in eleven months another specimen twelve and a half inches long, and weighing one pound, was caught in San Francisco harbor. This very rapid growth indicated the special adaptability of the waters of the region to this fish. In 1882 another plant, consisting of 300 fish, was made in the same region by the California authorities. As a result of these two small deposits, the species soon became distributed along the entire coast of California; its occurrence, however, in the other States of the region has not yet been determined.

The history of the striped bass is similar to that of the shad. It has attained considerable commercial importance, has increased steadily and rapidly, and is generally regarded as one of the best food fishes of the coast. It has not yet attained anything like the abundance of the shad, nor was this to have been expected from the meagre plants, but there seems to be no reason to doubt that it is only a question of time when it will become one of the most prominent economic fishery products of the region as well as a favorite object of capture by sportsmen.

The largest quantities of striped bass are taken for market in San Francisco Bay with seines and gill nets. The fish are found in greatest numbers between October 1 and February 15, but occur in some abundance at all seasons. Their average weight is eight or ten pounds, but fish weighing forty pounds are not scarce. The estimation in which they are held may be judged from the market value. In 1888, the ruling price in San Francisco was one dollar a pound; in 1892, owing to an increased production, it had dropped to twelve and a half cents. The catch in the latter year was about 43,000 pounds, for which the fishermen received $5,350. The aggregate yield to date may be estimated at nearly 100,000 pounds, with a value at first hands of about $18,000. The transportation of striped bass to the Pacific being undertaken conjointly with that of a number of other fishes, it is probable that the proportional cost of introduction was not more than a few hundred dollars.

TECHNICAL EDUCATION.

BY ALEXANDER MEEK, MUSEUM, PETERHEAD, SCOTLAND.

Mr. Morse has recently, in the *Atlantic Monthly*, advocated, and very ably, the extension of museums into the smaller towns. The success of the public libraries is as well known on this side as in America, and where museums have been established they have also been largely taken advantage of. And thus it is only fair that some definite purposes should be kept in view in their formation and in their arrangement. Such purposes the writer has set down elsewhere*, and there is little indeed to add or object to in the article above mentioned.

I hope soon to publish a description of a local museum, which has long had a quiet and dark existence in Peterhead, but which, with the institution of a reading room and free library, is now properly housed. The removal has been made the occasion of a complete revival and rearrangement in new cases. We hope to have it opened in a week or two.

There is no doubt at all of the educational value of such institutions. The pity is that so many are hampered by want of funds to carry on the work and to provide a neat-handed, educated person to look after the collection. Were it possible to build such museums and libraries with other educational activities, I fancy the solution of the problem of providing for education, even in remote districts, would be brought to practicable ground and might be gone on with at once.

Let me tell those who read *Science* one direction which education has recently taken in this country, and some thoughts that are suggested for its continuance and furtherance.

In towns, the youth who takes up a work or profession, is led at once, by contact with his fellows, to attend University or Evening Technical classes, where he learns principles underlying his daily work. But in the country districts, until lately, little attempt has been made to instruct farmers and fishermen.

And like all similar attempts, even when made in towns, the failure of the work was by many guaranteed. Those who have passed from school to university, who have devoted themselves to some special department of learning, furnish often the worst enemies to the scheme. But the funds came suddenly, and the trial was made. Well, it may be granted at once that an itinerant instructor can do very little real teaching, but if he can successfully, every night of his course, hold up an attractive picture of scientific work and its results to those in front of him, he should, if well trained, find that his work is not unavailing, that it is possible to thus stimulate an interest in the questions he handles, and then the free libraries are called upon that the pupil may follow it up. I can vouch, from my own experience in this field, for the interest taken in the lectures and for the encouraging enthusiasm evinced by those who attend—many travelling six miles for the purpose. The interest shown, of course, is due, in my case, to the country audience being so directly interested in my subject—the *Farm Animals*.

But still there is here, as with the museums, the want of co-ordination. Not only is such instruction very much needed in the country, and the desirability of the schoolmasters taking the great share of it, but a number of good central institutions in the larger towns where such a complex subject as agriculture could be taught by competent teachers in all the departments and with which the schoolmasters and itinerant instructors would have direct connection.

Should such an extension be adopted in America, I think you will see the desirability of having it emanate from such institutions of agriculture as are to be found in Germany, and as in Guelph, Canada, on your side.

With the schoolboards, the Science and Art Department and the Technological Institution in London, and the County Councils, not to add universities, free libraries and museums, we have institutions enough in Britain, but their want of connection and independence of effort are much to be deplored.

It would be invidious in a journal like *Science* to discuss how that may be done. But for the purpose alike advocated by the writer in the *Atlantic Monthly* and of extending education into the country, such co-ordination is to be recommended.

*Transactions of Buchan Field Club for 1893, etc.

PALENQUE HIEROGLYPHICS.

BY PH. J. J. VALENTINI, 351 LENOX AVE., NEW YORK CITY.

I have prepared a memoir, in which an accurate account is given, both of the sculptured centre-picture set into the rear wall of the so-called Temple of the Cross, Palenque, and of the text contained in the 201 squares of hieroglyphics on the two lateral tablets.

Since the discovery of this temple by J. Lloyd Stephens, in 1849, this text has been the subject of much speculation. It was thought to tell the migratory and colonial history of the fabled Toltec nation. It was imagined to be written in hieroglyphics capable of being deciphered by the aid of a proferred alphabet. Neither of these speculations will stand the test.

As to the structure itself, it stands on a small tumulus, and was devoted to the memory of a defunct priest, whose name does not appear. But his portrait seems to be represented in the large sacrificial scene. He is offering the idol of *Chac* to the sacred *Quetzal*, this bird being perched on the top of the *Tree of Life* (yak-die), the latter standing on a pedestal in the shape of a grotesque human skull.

The purport of the left-hand tablet, as may be inferred from certain peculiar features and their arrangement, is that of a brief abstract of the records of the Palenque Temple. The other lateral tablet appears to contain a sort of biography of the dead priest.

With the exception of only two symbols of the twenty Maya days, the remaining exhibit the same features as are known from Landa's work and the extant codices, only that they show themselves in most elaborate form.

No symbol for the month makes its appearance on these tablets. Mr. Foerstemann's theory of reading double-columns is untenable; consequently, also, that of his day-symbols allied to month-symbols. The one is contradicted by the conspicuous separation of the columns themselves and by many other reasons. The other is refuted by literary statements. Landa's pictures of month-symbols are not the traditional ones, but fanciful suggestions.

There is no trace on the tablets of the Mexican Tonalamatl reckoning, but, rather, of that of the ancient Tulan (Palenque) vigesimal system.

A phonetic base underlies the text neither as a whole nor in part. The hieroglyphics are of pure ideogrammatic nature. Moreover, the eye will not meet any object *profane*. The squares show only objects *sacred*, belonging to the cult, the temple, or such as were brought to it with the purpose of sacrificial offerings. Their identification offers no difficulties. Almost all of them were described and discussed by Landa.

At the suggestion of the lamented Professor Baird, Smithsonian Institution, this memoir was begun in 1873. Its substance was ready for print in 1877, when I made an agreement with Dr. Rau, that he should first publish the description of the Palenque tablet, No. II., which stands preserved in the National Museum, and I then follow giving the interpretation of the sculpture in full. Meanwhile, time, as well as the profound studies made in Maya archæology by various scholars, has contributed to perfecting the work in hand.

Deficient though it may be in many minor parts, I am desirous of publishing my views on this subject without further delay and of thus at last redeeming the pledges given.

HUMBOLDT AND BRAZIL.

The statement is often made, even by Brazilian writers, that not only were express orders given by the Portuguese government to prevent the entrance of Humboldt in Brazilian territory but that a price was set upon his head in case he was found within the limits of the colony. A recent interesting discussion in the columns of the *Jornal de Commercio*, of Rio de Janeiro, has brought to light the official documents relating to the case, which is thus seen to be less discreditable to the Portuguese government than is usually represented. It is to be remembered that prior to the removal of the Portuguese royal family to Brazil, in 1808, the colonial policy was an exceedingly narrow one, and that foreigners were jealously excluded from all the colonial possessions.

A official letter from the minister of the kingdom, Dom Rodrigo de Souza Coutinho, to the governor of Para, Dom Francisco de Souza Coutinho, with the date of June 2, 1800, states: "It being reported that a certain Baron Humboldt, native of Berlin, has travelled in the interior of America, has sent home geographical observations of the countries traversed, and a collection of 1500 new plants, and that he intends to direct his voyage to the upper parts of the captaincy of Maranham in order to examine desert regions up to the present time unknown, and as in the actual state of affairs this voyage without special orders of His Majesty is suspicious, you will cause to be determined with the greatest exactness and care if this or any other foreign traveller is travelling, or has travelled, in the territory of this captaincy, and in the affirmative case you will impede the continuation on such investigations, prohibited not only to foreigners but also to suspicious Portuguese not authorized by royal orders." The letter terminates recommending "the greatest circumspection, communicating at once to His Royal Highness, through this department of state, in order that he may take the steps required by faults of this nature."

In consequence of this order, Dom Diogo de Souza, governor of Maranham, sent a circular letter, under date of Oct. 12, 1800, to various local authorities, "recommending that if by chance the said Baron Humboldt, or any other foreign traveller, appears in your district, you will have him conveyed, with all his companions, to the capital, *without, however, failing to treat him with all decency, nor to give him good treatment and conveniences*, only accompanying him and impeding his means of transportation and the making of political and philosophic observations."

Concerning this matter an interesting letter from Baron Eschwege to Humboldt has appeared, in which he communicates that he learned from his friend, Antonio de Araujo e Azevedo, Count da Barca, who had been Portuguese minister at La Hague, Paris, St. Petersburg and perhaps, also, Berlin, where he had probably made the personal acquaintance of Humboldt, and who was afterwards prime minister in Brazil, that learning of this order, he wrote at once to the prince regent, begging not only its prompt revokement in order not to attract the reproval of all Europe, but that orders should be given to aid Humboldt in every way, and that such orders were actually given.

It thus appears that even the narrowest of Portuguese statesmen did not go to the length that is generally believed by their descendants and countrymen, and that enlightened men like Count da Barca were not lacking in Portugal at that time. Coming to power, a few years later, this statesman was the principal protector of Eschwege and the other foreign travellers that, after 1808, were allowed to penetrate freely in the interior of Brazil.

REMARKS ON THE TERNS OF LITTLE GREEN ISLAND, MAINE.

BY ARTHUR H. NORTON, WESTBROOK, ME.

The Little Green Island is located to the southwest of Penobscot Bay, about 55° N. lat., 69° 2 W. lon. About a mile north the Northern or Eastern Triangles, a group of sunken ledges, some rising above the surface a little before and after high water, are scattered, noted as fishing grounds, as good gaming places, and as places to be especially avoided by mariners. The place is about seven or eight miles from the nearest mainland, a round rocky island inhabited only by sea birds and such organisms as find a suitable dwelling-place here—excepting the birds, probably nothing higher in the scale than insects. Throughout the year it is visited by gunners and fishermen, who often camp for a few days, or mayhap, throughout the summer season.

This was formerly one of the largest tern resorts in the vicinity, though to-day it is interesting only in a historical sense. It had for years been visited by fishermen, who came on picnics to gather the eggs of the "medericks," or terns, *Sterna hirundas* and *S. Paradisœa.* As they killed very few of the birds, and only took the eggs that were sufficiently fresh to sink in a dish of water, no serious reduction in the numbers of the "medericks" was evident, until they were slaughtered for their plumes or breasts.

I first visited the place, and beheld the wondrous beauty and natural fascinations of this great population of birds, from June 16 to 18, 1885. It was a bright, fair day, and we arrived about noon, finding them in the midst of their daily labors. Our approach to the island aroused the solicitude of those nearest the sea, which rose from the ground in companies of considerable size, some to resettle on their eggs or resting places, while others were still rising; some struck out boldly to view us more closely and herald our approach in a strong, shrill voice, and were quickly joined by others coming from the sea, pausing for a moment, then hurrying to land or hanging overhead to vociferate angrily to the unabating numbers round us. Such was our reception, and from daylight until dark, of those days, every movement which we made was carefully guarded by those creatures. We found the nests all over the island, from the windrows of seaweed, left by early high tides, in the gravel and "popple stones" on the beaches, on the bald, jagged ridges of ledge, projecting seaward, back through the pasture land to the summit of the island.

That year the place afforded pasturage to a large flock of sheep, which kept the grass cropt short, furnishing unlimited nesting sites, as our terns dislike tall grass for breeding places. Some were mere depressions in the sand or grass, others contained a few feathers from the parent, straws, or pieces of seaweed, and occasionally they were quite well lined; and one found in July, which was placed about a foot from a wisp of drift hay, was lined with it to a remarkable degree, being compact and strong, truly a pretty specimen of bird weaving.

While wandering over the island we were accompanied by a restless, pleading throng, seeming like a dome of animated white flakes within the great, impassive dome of outer blue. Those that were more distant were settling to incubate their eggs or to rest, and others rising to join the troop. While walking on opposite sides of the island we were made aware of each other's position and course by the vigilant birds surrounding.

The nests contained one, two or three eggs, usually fairly well advanced in incubation. One nest contained four eggs, the only case which we noted, and we probaply examined hundreds of nests. Mr. Rackliff, my companion, who had visited the place for quite a term of years previous, and had probably examined thousands of nests in all, remarked that this was the second time that he had seen more than three eggs in a nest.[1]

While fishing at the Triangles and shoals around the island, the terns were our constant companions, approaching closely to our boat, hoping to secure refuse from the bait, or dressings from the fish. With fishermen, it is an unpardonable display of slackness "to dress down on the ground," and the small-boat fishermen usually dress on the beach or in harbor, or mayhap, on the trip to shore. Hence the terns were accustomed to gather in compact companies at these dressing stands, and at the Green Island beach I have seen them so closely crowded that it seemed wonderful that they could move without coming in contact at every sweep—a sight that prompted the "salts" to relate tales of slaying several at a single stone's throw through the mass, or of greater gatherings at other times.

Of this matter they seemed to feed but very little to their young, though the adults would become gorged with it and drop out from shore to alight on the water, drifting whither the wind and tide listed, occasionally rising to flap a short distance and resettle. During the heat of the day they were fond of basking in the sun, and at low water the Triangles and rocky points of the island were rendered especially attractive to the sight by the flocks of terns and Bonaparte's gulls reposing on their dark and treacherous brows; the whiteness of their plumages being suggestive of the soft white sea foam wont to settle there in the fury of the violent storms, whose sighs and groans have proven to be the funeral dirge of the mariners and their vessels which lie mouldering here.

The higher parts of the island and its beaches, especially the rocky ridges near the shore, were always adorned by their elegant forms, resting with stoical gravity. It required but a slight disturbance to send the whole gathering scurrying lightly through the air to a short distance, when they would return with inquisitive glances and impatient cries. They evidently incubated at intervals, at least, throughout the heat of the fairest days, and some were constantly going from or returning to their nests. Thus, when we were seated quietly on the beach, we viewed them in constant motion, their voices never quiet during daylight, and occasionally at midnight the wandering sheep provoked them to peals of solicitude or rage. Several times we found eggs trampled by the sheep, and it was a common sight to see a tern diving fiercely at one of these animals, to utter a prolonged syllable and rise for another dash, thus annoying it to make it move to another place. They often made similar dashes at us, coming within a few feet of our heads, and stories of their having pierced hats with their beaks were related by the fishermen. After the young hatched this boldness was more frequently displayed.

Raptorial birds were objects of intense hatred, and very seldom through the breeding season, it was claimed, ventured near the island. I had the good fortune to observe an osprey passing along the shore one day, and close behind followed a train of indignant terns vociferating wildly; and his hurried flight proved that it was an unpleasant company.

July 16 and 18 I revisited the place accompanied by my father, when many of the young were hatched out, and a very few were able to fly; still quite a large number of nests contained eggs. The downy young were very beautiful, their colors were pure, and their down faultlessly clean. The little creatures were weak, and cuddled among the pepples on the shore or in the grass on the uplands, and by the anxious clamor of the birds overhead were made conscious of a supposed danger, and without moving directed the gaze of their large black eyes at us, seeming to bear an expression of fear and pain for their helpless condition, which could not fail to move the feelings of the naturalist with pitying love.

Those that were partly feathered ran freely, as was indicated by numerous paths in the grass that now was several inches high and seeded, in places that had escaped the sheep. I "trailed" out several of these, and on being handled they maintained a rigidness of the body so perfectly that at first I wondered whether I had not found a dead bird; but the cautious expression of the eye quickly dispelled the presumption, and on my turning the little creature on its back, it quickly sought to recover itself, and as I retired a few feet, it waddled slowly for a few yards and settled snugly in the grass.

During this visit we spent considerable time fishing at the Triangles, and for the benefit of the birds threw the fish livers overboard. This never failed to gather a large company of birds, and they grew to expect this attention, and after a short time the birds that were near would come to look for food at a swing of the arm above the head. At first they were very cautious, often dipping down to the water, but instead of seizing the food would raise their heads to look for danger, and, as they never lighted, passed onward and up bearing the liver; or in some cases the flight was so hasty that the grasp could not be effected. Soon, however, they became perfectly fearless of us, scaling across the boat to secure pieces within three feet of the side, and on several occasions they brushed my hat with their wings. While thus feeding they swooped down, pausing and frequently touching the tail and toes into the water, bowed the head, and took the article in the bill to be swallowed in the air or rarely to be borne shoreward.

Viewed thus in their active, vigorous conditon, they exhibit their gracefulness and beauty in a most pleasing way, the pearly blue mouth, lustrous black cap reaching to their large eyes, which in their closeness seem glowing with excitement, the carmine bills and tiny red feet, long slender wings and undulatory tail-feathers, are especially noticeable, as they glide with arrowy swiftness, their slight bodies and close-set plumage being perfectly adapted to the aerial path which they pursue. Nature must have labored long and skilfully to produce a beautiful, active creature to inhabit these lonely and often desolate sea-isles through the pleasant summer season.

By sunset most of the great number had come ashore and settled for the night. A gun fired after they had become quiet seemed to have the effect of a dynamite blast, as the colony of birds shot upward like so many thousands of snowy fragments hurled to the darkening sky. One evening after dark, in my father's company, I sauntered out over the island where few nests were placed. As we gazed upward we could just discern the birds gliding in the dusky starlight overhead, having risen from their resting places on the ground.

Near noon of the 18th we sailed away, losing this colony of terns from view, not for a season, but forever. During the next year, 1886, the Little Green Island, through the magnitude of its tern population, attracted

1 It is now not uncommon to find four, five and occasionally six eggs in a nest in Maine and Nova Scotia.

the attention of plumers, through whose depredations it became wholly depopulated in this single season, none breeding here in 1887 nor 1888, as I learned through a letter from Mr. Rackliff.

AN ANALCITE COPPER BOWLDER FROM THE KEWEENAW RANGE, MICHIGAN.

BY E. O. HOVEY, PH. D., NEW HAVEN.

In the Michigan exhibit in the mining building at the Columbian exposition there is a curious bowlder, or rounded mass, which deserves more than a passing glance from the visiting mineralogist. The bowlder was originally about four feet in diameter and approximately spherical in shape. It came from the Central Mine, Keweenaw County, and occurred near the contact between the ore body and the country rock. Possibly it was one of the contact phenomena of the region, and there may be other masses like it.

The bowlder is composed for the greater part of granular pink analcite with granular calcite and quartz quite evenly disseminated through it. It shows a tendency to spherical parting throughout the mass, which causes it to separate into concentric shells from one to two inches thick when broken into. Permeating the granular mass and holding it together, is an intricit net-work of arborescent native copper radiating outward from the centre of the bowlder. The action of dilute hydrochloric acid dissolves out the analcite and calcite, leaving the net-work of wire copper intact, with small grains of quartz caught here and there in it. The wires making up the arborescent growth are about 0.01 inch in diameter, but means for accurate measurement were not at hand. Under the microscope the net-work is seen to be made up of minute crystalline growths developed along axes inclined 60° to the direction of growth. The planes recognized were only the most common of those occurring on native copper; viz., the cubic, octahedral and dodecahedral. The terminations of the little branches are usually acute, and formed by the acute solid angle of the dodecahedron; but an occasional blunt point occurs made up of what seem to be cubic planes. The vertical axes of the crystals are approximately the radii of the spherical mass, and the extremities of the little branches all point outward. A low estimate places the amount of native copper in the bowlder at from 35 to 40 per cent. The crevices in the mass are stained green by the decomposition products of the copper.

The chief component of the bowlder and the one which gives it its color is pink analcite, recognized by its faint cubic cleavage, its vitreous lustre, inclining a little to pearly, and its gelatinizing with dilute HCl. The granular structure is so pronounced that the mass would crumble to pieces between the fingers, if it were not for the retaining net-work of copper. Disseminated through the analcite are small aggregations of granular white quartz, while associated with both analcite and quartz are minute particles of calcite, which occur in sufficient quantity to produce marked effervescence when the rock is placed in acid. The copper penetrates all components of the rock alike.

The peculiar structure of this mass was noted by Mr. Samuel Brady, M. E., of Detroit, superintendent of the Michigan mineral exhibit, and the bowlder secured for the display at the exposition. A more detailed account of the mass and its occurrence will appear in Mr. Brady's report on the exhibit, but he kindly gave me permission to prepare this preliminary notice for the readers of *Science*.

LOEW'S NATURAL SYSTEM OF THE ACTIONS OF POISONS.

BY J. CHRISTIAN BAY, MISSOURI BOTANICAL GARDEN, ST. LOUIS, MO.

Hitherto, the actions of poisonous substances were regarded mainly in connection with medical science or, when submitted to a general view, were mainly considered in their relation to certain physiological conditions of the mammals, or with reference to pathology. A review of poisonous actions was extended only as far as we could go with regard to the chemical composition of the matter acting, and with the pathological state of the whole organization upon which it exerted its influence. Thus, in 1862, Taylor established a classification of poisonous substances into mineral, vegetable, neurotic, spinal, and cerebro-spinal poisons. But this division did not, in the first place, cover all instances of which we had a record. Further, it was not, for logical reasons, really satisfactory.

The grand development of bacteriology, and much ingenious work in investigating the structure and physiological properties of the living matter, have extended our positive knowledge as well as our views, and special attention has been paid to the physiological unit of the cell. In this journal the writer [1] called attention to Sachs' [2] theory of the energids, in the *Botanical. Gasette* [3] he called attention to Wiesner's magnificent work [4] in similar direction, and Detmer's [5] recent contribution, which, though they go in different directions, can very well extend and be supported by each other.

Through many special papers and occasional notes, our knowledge of the actions of poisons has been extended, since the old school of physiologists saw other systems of knowledge come forth. In this connection, attention should be called to the work of Pereira and Buchheim [6]. Now, however, the facts are arranged in a totally new, very logical and natural way, by Dr. O. Loew, [7] of Munich, who has established a natural system of the actions of poisons, corresponding with our present knowledge and views of the elementary units of the animal and vegetable body.

Loew arranges poisonous actions according to their way of action upon the organization, thus establishing a physiological system. This is to be preferred to any other, because many of these actions open views into the chemical and physiological properties of the protoplasm and its constituents. The support of this system is Pflüger's theory from 1875 [8] that the properties of living and dead matter (or matter in the living and dead state) are intimately connected with the properties of the organic proteid combinations in the protoplasm. This question was, in 1882 and later, subject to exceedingly careful and important experimental studies by Loew and Bokorny, [9] the result of which being that the albuminoid matter of the protoplasm of plant cells in the living state differs greatly from that in the dead state. Much opposition against the conclusions from the many important facts herewith connected results mainly from lack of understanding of these questions, while, on the other hand, there are good reasons for opposing. The *facts*, however, cannot be rejected.

1 Science, XXI., p. 162, 1892.
2 Flora, Regensburg, 1892, pp. 57-64.
3 Bot. Gaz., XVII., 1892.
4 Die Elementarstruktur und das Wachsthum der lebenden Substanz. Wien, 1892.
5 Berichte der Deutschen Bot. Gesellschaft, X., p. 433-441, 1892.
6 Pereira: Handbuch der Heilmittellehre, ubersetzt von R. Buchheim. Vol. I-II.
7 Loew, Dr. Oscar: Ein naturliches System der Giftwirkungen, Munchen, 1893. The work is dedicated to Professor von Pettenkofer on his 50 years' doctor-jubilee.
8 Pfluger's Archiv f. d. ges. Physiol. des Menschen und der Thiere, Vol. X., 1875, p. 300. See also Detmer: Pringsh. Jahrb. XII., and his Pflanzenphysiologie, 1883, p. 149-153.
9 Die chemische Kraftquelle des lebenden Protoplasmas, 1882. See also Biol. Centralbl.

The structure of the active albumen is highly labile, it is easily altered, and transformed into an inert mass. The protoplasm, being equally labile, *possesses its vital force in consequence of the balance between the attractive and repulsive forces of the proteid molecule.* When this balance is disturbed by an excess of the attractive power over the repulsive, we have a disturbance of the vital power. It must be confessed that this theory explains well the death of the living matter.

From this foundation Loew builds up his theory. With wonderful patience he has collected the notes from the literature, and succeeded in bringing together a reference-work of high rank, while, at the same time, original observations are frequently broadening out the scope and giving numerous suggestions for further investigation. As the work is altogether a work of facts, only a general view will find its place here.

The system is the following:

A. General Poisons.
1. Oxidizing poisons.
2. Catalytic poisons.
3. Poisons operating through the formation of a salt.
4. Substituting poisons.

B. Special Poisons.
1. Poisons which affect solely such acting albumen as has a special configuration and lability: toxical proteids.
2. Poisons which have a destructive effect on the structure of the cells, in consequence of their association with the active albumen of the protoplasm.
3. Poisons which have an indirect effect;
(*a*) checking the breathing power,
(*b*) acting by their own decomposition,
(*c*) altering the swelling up of organic bodies.

The toxical proteids (chapter V) are treated in full. "The discovery by Hammerschlag in Nencki's laboratory (1888) that a poisonous proteid could be isolated from the *Bacillus tuberculosis*, was succeeded by the important observation by H. Buchner (1889) that certain proteids are present in the blood of certain animals and have a poisonous effect on bacteria. Emmerich had already, in 1887, shown the destruction of bacteria in the circulation; then he succeeded in showing that the bacteria-killing properties of the blood rested in the albuminoid substances contained therein."

The multitude of facts makes it possible to give only the main features of Loew's theory here. Everybody who is interested in physiology and its progress knows that we must have views as well as facts in order to secure a constant progress. The importance of the new theory will be felt by all who are interested in medical science; it is one of the steps that show us that the time has come for establishing a special general physiology of animals and plants. All this made it a pleasure to the writer to turn the attention of fellow-workers towards it.

SOME OHIO MOUNDS.

BY HAROLD HEATH, DELAWARE, OHIO.

DURING the last few years several mounds in central Ohio have been entered and some of the data obtained has proved to be of considerable interest. Mounds similar to these have long been described under the title of Funeral Tumuli and Sacrificial Mounds, yet their true function seems to be doubtful even in the present day. They were about of equal size, varying from 40 to 50 feet in diameter and 15 to 20 feet in height, and without exception were situated upon some water course. In the cases where the land was still undisturbed a layer of vegetable mould covered the surface to a depth of between two and three feet. Beneath this covering came a layer of fine sand and gravel similar to that found in the sand bars of streams or rivers. This layer was always four or five feet thick. In making shafts extending perpendicularly through the centre of the mound, after passing through this gravelly layer, a rough altar was reached in four cases out of six, and in the other two ashes and charcoal were found. These altars were constructed of unhewn, waterworn bowlders piled in a rude fashion to form a mass having the average dimensions of 5.3 feet in length; 4.1 feet in width, and 2.4 feet in height. In two other cases, which have come to my notice, skeletons, evidently Indian, were found in this gravelly superficial layer above the altar. One skeleton was especially remarkable for its height, measuring when put up a trifle less than six feet. About and upon the altars were scattered ashes and charcoal, and dark masses of vegetable mould indicated decayed bits of wood. Portions of human skeletons and in one case that of some carnivorous animal were found, many pieces in a charred condition, indicating either human sacrifice or cremation. These altars were built before a rude pavement of stones similar to those composing the altar and were of about the same size, viz., about a foot in diameter. Beneath this lay a mixture of blue and yellow clay and gravel making up the greater portion of the mound. In one case layers of gravel stones about the size of a cricket ball were encountered lying in strata separated by about a foot of this clay-gravel mixture. These layers extended through a depth of nine feet. This "cement" was so compact and hard as to withstand almost like stone the most persistent attacks with pick and shovel. In most cases the work was abandoned after sinking the shaft to a depth corresponding to the height of the mound, although the clayey cement indicated that the lower surface of the structure had not been reached. In only one case when a depth of nineteen feet had been reached by means of excavations and blastings was a skeleton found. This was the skeleton of a man 5 feet 1 inch in height and it was so fragile in the damp tenacious clay that only portions of the bones could be extracted. The body lay partially upon the right side, one hand lying across the breast, the other extended along the side. The left leg was considerably flexed, while the right was extended. Lying at the side of the skeleton were two stone beads, a perforated bit of unio shell and two flakes of mica. A further excavation of six feet, and also large tunnellings at the foot of the shaft, failed to bring to light any more bones or implements.

In two other mounds implements were found in this thick cement—an axe in one and two fleshers and several rough spear heads in the other. In other localities a few cases have been reported where a kind of vault was found a short distance beneath the altar, containing one or more skeletons and generally some implements or ornaments, but so far as I can determine no such report has been made for this section of the country.

AN EYE PROTECTOR TO BE USED WITH THE MONOCULAR MICROSCOPE.

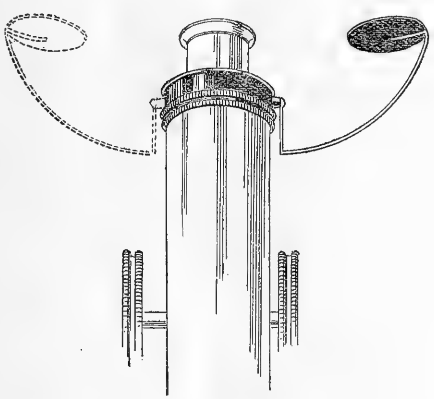
BY L. BREWER HALL, M. D., PHILADELPHIA.

How often have we heard persons exclaim, upon looking into a binocular microscope for the first time: "Oh, how much easier it is to see with this instrument, and how much plainer everything appears;" and this *with one field quite dark*, which provokes a smile from the amateur. I am fully convinced, however, that we cannot ascribe such expressions wholly to dissimulation or flattery, or even self-deception, and for the following reasons:—

When one eye is looking through an instrument like the microscope, and the other, being open, is regarding the objects outside the tube, an image is formed upon each retina, and the normal action of the mind is to blend them into a single picture. This being impossible from the difference in the objects, a strong mental effort is required to disregard the impression in one eye, and fix the attention upon the other only. Again, when we close one eye by the contraction of the orbicular muscle, or by pressure, as with the hand, we cause contraction of the accommodating muscle, also, and that of the open, occupied eye, as well. I have proof of this many times each day while examining eyes by the ophthalmoscope; but we are all familiar with the spasm in *both* eyes when a particle of dust is beneath the lid of one only; and, again, we are conscious of an effort amounting almost to an impossibility, before training, of keeping one eye open and the other shut.

Both these conditions are present and are factors in the fatigue which accompanies the use of a monocular instrument, and are strong reasons for employing a binocular one, when possible. Of course, each form has its own especial use and place, but this is not our present purpose to discuss. It is to overcome these sources of fatigue in the use of the monocular instrument that an eye-protector is used.

When anything is placed far within the focus of an eye no image of it is formed upon the retina, and it becomes invisible. If, then, it should be opaque and large enough to cover the whole field of vision, it is not only invisible, but shuts off the sight of all other objects as well, leaving the mind free to attend to the image on the retina of its fellow. On this principle quite a number of devices have been proposed and used, among which a plain card, perforated and slipped upon the tube, has been, perhaps, the most frequent. This has to be placed low down in order to be out of the way of the face, and thus requires to be so large to cover the field of vision that it hides the stage and interferes with the adjusting screws.



Another consists of a small plate extending horizontally from the cap of the ocular. In this the edge must be cut away to admit the bridge of the nose. This gives it a curved form, and prevents its being used before each eye alternately, except by removal and inversion. It must also be removed with each change of ocular. These removals and replacings demand so much time that most workers think it hardly worth the trouble.

The form that I have found satisfactory, after use for several years, consists of a small disc of blackened brass, about the size and shape of a spectacles glass, and supported near the eye by a wire extending from its outer margin obliquely downward to a point on the tube low enough to be out of the way of the nose, then bent upwards, parallel to the tube, but not touching it, and attached to a cut-ring which clasps the top of the draw tube beneath the ocular. The accompanying drawing shows it in place, and will need no further explanation.

The advantages of this form are: First—The small size of the disc and support interfere the least possible with the adjusting screws and view of the stage. Second—It is easily adjusted to the eye-distance of any worker. Third—It is not in the way of the nose. Fourth—It can be easily swung around before either eye, without removal. Fifth—It is not disturbed in changing oculars. Sixth—Any mechanic can make one at a small expense. The one I am using was made by Zentmayer, of this city.

LETTERS TO THE EDITOR.

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

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

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

Birds That Sing by Moonlight.

The reading of the very interesting article in *Science* for Dec. 2, entitled "Birds That Sing in the Night," by Morris Gibbs, brought vividly to my mind the pleasure I have felt in listening to nocturnal bird music.

The birds which I have most frequently heard sing at night here in southeast Kentucky are of different species from those mentioned by Mr. Gibbs, prominent among them being the Oven-Bird (*Seiurus aurocapillus*), which, although I have never seen any mention of the fact in print, sings regularly on moonlight nights.

On such occasions the song is usually the extatic, quivering jumble of warble and twitter so often heard from this bird at dusk, when he flies in zig-zag lines and short curves up above the tops of his native woods, and as quickly descends, all the time bubbling over with melody.

Almost every bright moonlight night in spring and early summer this song may be heard at intervals, breaking with silvery sweetness into midnight's tranquility.

Another bird, often heard on moonlight nights, though by some it is not considered worthy the name of a song, is that of the Yellow Breasted Chat (*Icteria virens*).

The Cuckoos are also often heard by moonlight during their southward migrations after all the resident individuals have departed.

I have frequently noticed that a bright fire in or near the woods at night called forth sleepy chirps and snatches of song from various species of birds. John B. Lewis.

The Cambojan Khmers.

Having some time ago carefully studied the question of the origin of the Khmers of Cambodia, and the result of my enquiries having been published in the *Revue d'Anthropologie* (3rd Ser. Vol. I, 1886, 2d fasc.), under the title of *Les Cambodgiens et leur origine*, I may perhaps be allowed to make some remarks on Prof. A. H. Keane's letter which appeared in *Science* for August 4. That the Khmers belong to the white race, whether this be called Caucasian or not, cannot well be denied, and Mr. Keane is doubtless entitled to the credit of having first pointed out the fact. But that the Khmers are, as he states, true aborigines in the country where they are now found is very questionable, and indeed the best French authorities agree with Dr. Maurel in deriving them from India. The date of their arrival in Cambodia is given by M. Moura, and is fixed by the annals of the ancient Cambodian empire as having taken place about 543 B. C. According to the view elaborated in the paper above referred to, the ancestors of the Khmers were allied to the Tandavas of the Hindu epic, the Mahabharata, and I have endeavored to prove that they belonged to the Rajpoot-Jat stock of N. W. India.

As to the language of the Khmers, M. Moura, judging from the fact that it contains many Sanskrit or Pali words, supposes it to be of Sanskrit or Pali origin, which agrees with the Indian origin of Cambodian civilization and religious ideas, but not with Mr. Keane's statement that the language of the Khmers is "radically distinct from the Indic (Sanscritic branch of the Aryan), but closely allied to the untoned polysyllabic Malayo-Polynesian linguistic family." M. Moura affirms that "one of the distinctive features of the genius of the Khmer language" is its monosyllabic form. How far this is consistent with its supposed Sanskrit or Pali affinity I am not concerned to say, although it is noteworthy that words derived from Pali have been reduced by shortening to the monosyllabic form. From a comparison of the vocabularies given by M. Moura, I much doubt whether there is so close a relationship between the Khmer and the Malay languages as Mr. Keane supposes. The latter is more nearly related than the former to the primitive Cham, and while Malay has derived certain foreign elements from the south, the Khmer has obtained its foreign elements from the north. On this subject I would refer to a paper by myself on "The Asiatic Affinities of the Malay," published in the Proceedings of the American Philosophical Society, Vol. XXVIII., June 3, 1890. In any case, I cannot see how the fact of the Khmers having untoned polysyllabic speech could be evidence, as supposed by Mr. Keane, that they were aborigines, nor is this proved by the existence of allied so-called wild bribes. C. Staniland Wake.

Chicago, Aug. 12.

Oregon Wax.

If Mr. C. D. Hiscox will refer to the letter of Mr. James Wickersham, in *Science* of July 7th, he will find that the wreck origin of the Oregon wax is not an "absurdity." Having examined specimens of the wax in question I beg to state that it has nothing in common with ozocerite, with which I am perfectly familiar, but is apparently beeswax, pure and simple. It is of a yellowish-brown color, with granular fracture, and is lustrous on cut surfaces, but not resinous. Its odor is honey-like and characteristic. A hasty chemical examination for cerotic acid showed 6.7 per cent in a sample cut from near the surface of one of the lumps, this figure being low for pure wax and yet rather higher than is usually the case in the impure, so-called, beeswax of commerce. Mr. Hiscox will remember that ozocerite yields no free acid on treatment with alcoholic potash. Charles Platt.

Buffalo, July 25.

Bacteria in Hens' Eggs.

In *Science* of August 4, Mr. Brannon asks for some information in regard to the decay of eggs.

Some two years ago a student in the hygienic laboratory was given the problem to determine whether the putrefaction of eggs was due to bacteria entering the egg as it passed through the oviduct or through the shell after the egg was laid. The results obtained were not satisfactory or conclusive, but as they may throw some light on the subject they are given (from memory) for what they may be worth. Many cultures were made from stale eggs in order to determine whether the putrefaction was due to a specific germ or to a number of different germs. Several species were found.

A healthy, laying hen was obtained and after repeated washings in a solution of bichloride of mercury, followed by sterile water, she was placed in a sterilized cage. The hen continued to lay regularly every other day. The eggs were obtained as soon as possible after being laid, and a portion of them were placed in sterilized cotton and then in an incubator. If my memory is not at fault, all of those eggs decayed and swarmed with bacteria.

The remaining eggs were taken as soon as laid, and cultures were made from their contents. Some of these culture tubes developed; others remained sterile.

After some days the hen was killed, and with proper aseptic precautions culture tubes were inoculated from various portions of the oviduct. Most of these tubes developed. It would seem from this one case that the putrefactive bacteria entered the egg in its passage down the oviduct and before the shell was formed.

But to conclude that all eggs when laid contain putrefactive bacteria is not warranted. It is a matter of common household observation that a few eggs do not decay, no matter how long they may be kept, and the further fact that eggs packed in some dry material, as sawdust, salt, etc., and those greased or coated with gelatin, etc., seem to keep longer than those left in the open air, would seem to indicate that the bacteria enter through the shell.

I regret that these experiments were not completed.

The point is one of considerable hygienic and even commercial importance and one that needs but a little careful work to settle beyond question.

Charles T. McClintock.

University of Michigan, Ann Arbor, Mich., Aug. 11.

Correlation of Tejon Deposits With Eocene Stages of the Gulf Slope.

While comparing the Texan Eocene fossils with type specimens and others in the collection of the U. S. National Museum and in the Philadelphia Academy of Natural Sciences I have been impressed with the remarkable sameness in faunal characters throughout the vast extent of the lower Claiborne, or Lisbon, horizon; many of the species from South Carolina are identical with those from the banks of the Rio Grande, and the rocks from Ft. Téjon, California, furnish a very similar fauna with several identical and many more analogous species. Gabb's *Cardita hornii* is *Venericardia planicosta* Lam. as held by Conrad; the type specimen is slightly malformed and imperfect, but others from the same locality are quite typical *planicosta*. Gabb's *Architectonica cognata* is Conrad's *Solarium alveatum;* Gabb's *Architectonica hornii*, Conrad's *Solarium amœnum;* Gabb's *Neverita secta*, Conrad's *Natica œtites*, and so on. Gabb's peculiar and characteristic little *Whitneya ficus* is known from Alum Creek Bluff, Colorado River, Bastrop Co., Tex., and is in itself a strong argument for the synchrony of the Texan and California beds from which it is derived. Moreover, in deposits of this horizon on both sides of the Rockies, there are similar developments in the genera *Crassatella, Cytherea, Pyrula, Levifusus, Rimella* and others.

With the above facts in mind I cannot help suggesting that those who have an opportunity to study the Eocene series of California (Téjon deposits) would do well to look for the Midway stage which ranks second in persistency among the subdivisions of the Eocene along the Gulf slope. In other words search should be made along the Chico-Téjon contact for such species as *Enclimatoceras ulricii, Cucullœa macrodonta, Ostrea pulaskensis*, together with varieties of *Venericardia planicosta, Turritella mortoni, T. humerosa*, and other Midway forms.

Gilbert D. Harris.

Geological Survey of Texas, Washington, D. C., Aug. 1.

An Addition to the Myology of the Cat.

In St. George Mivart's book on the cat there is to be found one of the most extensive articles on feline myology ever written, nevertheless there seems to be a muscle in the hind foot not mentioned in his work or anywhere else as far as I can ascertain. It takes its origin by a broad flat bundle of fibres from the outer side of the Os Calcis immediately below the anterior prominence, these run obliquely forwards forming a comparatively broad, thin tendon, which blends on the plantar surface with, for the most part, the Flexor-longus-pollicis, where it joins the Flexor-longus-digitorum-pedis, but a few fibres of the tendon go to the latter muscle.

It is innovated by a branch from the external plantar. That this muscle is not an abnormity I am quite sure as it has been found in 25 subjects from the vicinity of New York and one from Italy.

Joseph W. Thompson.

Clifton, Staten Island.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U. S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | - will exchange for any works or pamphlets on American Slugs or Anatonry of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

I wish to exchange a New Model Hall Typewriter, price $30, for a Daylight Kodak, 4x5 preferred. George A. Coleman, Dep't. Agric., Div. of Ornithology, Washington, D. C.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St., Newark, N. J.

A complete set of Bulletins of U. S. Geological Survey, various reports and bulletins of surveys of Missouri, Arkansas, Minnesota, Alabama, Illinois, New York, Pennsylvania, Indiana, Ohio and Texas; iron ores of Minnesota; Wailes' Agriculture and Geology of Mississippi (rare). To exchange for periodicals and books on Entomology or for Lepidoptera. Rev. John Davis, the Deanery, Little Rock, Ark.

Wants.

I would be grateful to receive replies to any of the following questions.—Is copper found native in Mexico? Is it found native in Cuba? If so, in either or both cases can I purchase authentic specimens? Can any one furnish me with results of analyses of native Mexican or Cuban copper, also analyses of unalloyed copper reduced from the ore from Cuba or Mexico? Is it possible to procure aboriginal implements of copper from Cuba or Mexico? Answers to these questions will greatly aid the preparation of a report for a scientific institution. C. B. Moore, 1321 Locust St., Philadelphia, Pa.

Wanted.—J. W. Draper's book, the forces producing the organization of plants, 1844. Wanted for my private library. Address J. Christian Bay, Missouri Bot. Garden, St. Louis, Mo.

A graduate of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

Wanted.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

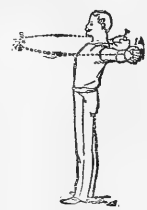
Wanted.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.



6
Shoulders and Upper Back good for Round Shoulders

SCIENCE

ELEVENTH YEAR.
VOL. XXII. No. 551.

AUGUST 25, 1893.

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SCIENCE

NEW YORK, AUGUST 25, 1893.

AN EXHIBIT OF RELIGIONS.

BY MERWIN-MARIE SNELL, 593 LA SALLE AVE., CHICAGO, ILL.

In the month of September there is to take place in Chicago an event which promises to be epoch-making in the history of religions, and perhaps, by its ultimate consequences, in the general history of mankind. I refer to the World's Parliament of Religions, at which the representatives of the Catholic, Oriental and Protestant forms of Christianity, with their various sub-divisions, will meet on equal terms with those of the different sects of Judaism, Mohammedanism, Hinduism, Buddhism, Jainism, Parseeism, Confucianism, Taoism, Shintoism, and other non-christian systems.

These religious bodies will present to the Parliament, through their accredited representatives, a statement of their teachings, practices and claims, and many of them will also have special congresses of their own, in which their doctrines, histories and practical methods will be still more fully exhibited.

It is believed by many of the friends and participants of the parliament that it cannot fail to give rise to a mutual understanding and appreciation between the world's religions, altogether unprecedented in the past, and that it will result in a vast increase in the spirit of human brotherhood, the lack of which has been the cause of many of the darkest chapters of history, and has constituted the greatest of all obstacles to the progress of the race.

But it is to its scientific, rather than to its religious or social value, that I wish to call attention. Although many of the foremost European and American specialists in comparative religion have prepared papers for the congress, or promised their personal attendance, the attention of the scientific world at large has not yet been sufficiently drawn to the extraordinary opportunities which it will present to serious and disinterested students.

It is true that it is in no sense a scientific congress, although several of its sessions will be devoted to the scientific view of religions, and these will be participated in by men of world-wide fame as the very foremost representatives of hierological science—men like Müller, Tiele, d'Alviella, Harding and the Révilles. It is true that the religious bodies participating have at heart, in most cases, the interests of their own propaganda; they hope to make so favorable a representation of their own special systems as to break down any prejudices of which they may be the objects, and to attract at least the respectful interest, if not the adhesion, of many of those who hear them.

But these facts, so far from decreasing the scientific value of the parliament, are really its essential conditions. It is a truism to say that the collection of materials is the most important part of any inductive science, since the science can be genuine and its results definitive only so far as its basis of observed facts is broad and adequate. Now there is no existing science in which more still remains to be done in the collection of materials than in comparative religion.

Many hurried inductions have been made on the basis of a few ill-observed and ill-assorted facts recorded by missionaries and travellers, whose opportunities, training, or habits of mind, have not fitted them for collecting thoroughly authentic data. Only a small proportion of the sacred books of the world have thus far been translated by European scholars and placed within the reach of the student; and these books can have but a partial and preliminary value so long as the complicated systems which have produced them, or grown out of them, have not been studied in the details of their historical development, subdivision, reproduction, inter-action and fusion.

What does European scholarship know, for example, about the religious development of India, in spite of the vast amount of good work which has been done in that field by Vedic scholars, general philologists, and other classes of students? There exists to this day but one professedly original résumé (and that very imperfect, and based to a large extent upon a native work) of the *existing sects* of Hinduism, and from this all other descriptions have been, for the most part, copied or abstracted.

Who is there, even among professional Indianists, who is thoroughly acquainted with the various ramifications of either Vaishnava, 'Saiva or 'Saktî Hinduism, the dates and circumstances of origin of the sects into which they are divided, the minutiæ and sources of their doctrinal and practical differences, and their relative dependence upon ancient Vedic or non-Vedic Aryan religion, the pre-Aryan cults of Bactria and India, Mohammedan and Christian influences, the old and new philosophical schools, and internal processes of corruption and decay or of constructive or agglutinative development?

Again, every competent student of religions knows how difficult it is to catch the exact flavor or spirit of Oriental, or even of savage thought, and how, almost inevitably, it receives a certain foreign coloring whenever it is transmitted through a cultivated Occidental brain. Thus far very few descriptions of the non-christian religious sects of the East, written by native adherents of those religions, have been obtainable.

It is to be further noted that those students of hierology who approach the subject from the philological standpoint, are apt to pay too much attention to the terminology of religions and to their archaic literary monuments (which sometimes represent ideal systems that have never been actually carried out to any great extent) rather than to the successive transformations of their popular and pragmatic forms, the study of which is really as much more important as it is more difficult.

On the other hand, those whose primary interest is ethnological, are equally prone to consider, even in the more advanced religions, the *paraphernalia* of the cult and the *media* of doctrine, to the detriment of the theories and *Weltanschauungen* themselves, which form, in every case, the soul of the system.

The science of religions can never rise above the level of an empty empiricism, and no definitive results can be attained in it, until every class of religious facts shall be recorded with absolute impartiality, and religions studied as a whole—their doctrines, philosophies, spiritual and moral disciplines, biblical and liturgical constructions, sacramental and ceremonial systems, organization and functional specialization, methods of instruction and propaganda, and fortuitous non-religious ingredients, with due distinctions between the official and popular elements, and, whenever they have an ascertainable history, in an exact chronological order. A dogma is as acceptable a datum for the science of religions as a myth, or an altar-stone, or a ceremonial mask, and the religions that are nearest us are no less in importance than those that are remotest. Every one who is cognizant of the universality of law must recognize that all the changes in the recent religious life of Christendom, for example, are subject to the same laws of religious evolution and dissolution that have governed the whole religious history of the globe.

If these allegations are correct, a collection in which all the principal religions of the Christian and non-Christian world are presented in the way in which they are understood and practised by their own followers, must be of incalculable value, bringing together an enormous body of materials, such as could not have been collected by individual enterprise, even at the cost of years of labor and observation.

Were it an exclusively scientific assemblage, it would not be the vast repository of data which it is to be, and it could do nothing else than to further the breeding in and in, as it were, of scientific thought and speculation on a line where a vastly enlarged field for induction is the chief desideratum.

The proceedings of the parliament will form an invaluable addition to the materials for the study of religions, but as many as possible of those who take a scientific in-interest, in the subject, should attend the parliament in person, so that they may in face-to-face intercourse with the picked representatives of the Christian, Jewish, Moslem and pagan sects and sub-sects, if not by their action in the great congress itself, bring out and note for their own use, and the future uses of science, the many facts which will otherwise fail to be collected.

NOTES AND NEWS.

THE following are the officers of the American Association for the Advancement of Science elected for the ensuing year: President, Daniel G. Brinton, Media, Pa.; Vice-Presidents—Section of Mathematics and Astronomy, George C. Comstock, Madison; physics, Wm. A. Rogers, Waterville, Me.; chemistry, T. H. Norton, Cincinnati, O.; mechanical science and engineering, Mansfield Merriman, South Bethlehem, Pa.; geology and geography, Samuel Calvin, Iowa City, Ia.; zoölogy, Samuel H. Scudder, Cambridge, Mass.; botany, L. M. Underwood, Greencastle, Ind.; anthropology, Franz Boas, Worcester, Mass.; economic science and statistics, Harry Farquhar, Washington, D. C.; Permanent Secretary, F. W. Putnam, Cambridge, Mass. (re-elected); General Secretary, H. L. Fairchild, Rochester, N. Y.; Secretary of the Council, James L. Howe, Louisville, Ky. Secretaries of the Sections—Mathematics and astronomy, W. W. Beeman, Ann Arbor, Mich.; physics, B. W. Snow, Madison; chemistry, S. M. Babcock, Madison; mechanical science and engineering, J. H. Kinealy, St. Louis, Mo.; geology and geography, Wm. H. Davis, Cambridge, Mass.; zoölogy, Wm. Libbey, Princeton, N. J.; botany, C. R. Barnes, Madison; anthropology, A. F. Chamberlin, Worcester, Mass.; economic science and statistics, Manly Miles, Lansing, Mich. Treasurer—Wm. Lily, Mauch Chunk, Pa. (re-elected.) Considerable discussion has taken place in relation to the place of meeting for 1894, but it is still undecided. Boston and Worcester, Mass., Providence, R. I., and Brooklyn, N. Y., have all been referred to, but the matter is left in the hands of the President and the Permanent Secretary for decision. San Francisco is spoken of as the place for meeting in 1895, and an invitation has been received from Nashville, for 1896.

—The U. S. Bureau of Education has issued a large paper-covered volume on "Benjamin Franklin and the University of Pennsylvania." It is edited by Francis N. Thorpe, professor of American constitutional history in the university, and the part directly relating to Franklin and his views upon education is written by Mr. Thorpe. He begins with an account of Franklin's own self-education, the Autobiography being mainly drawn upon as authority, and Mr. Thorpe expresses the opinion that "the influence of Franklin on American education has been even greater through his Autobiography than through the institutions which he founded, or which were founded by his followers." The movements that led to the establishment, in 1749, of the Public Academy of Philadelphia, the patent of the present university, are carefully recorded, and several important documents relating to its history are presented, including the circular by Franklin, in which he proposed its establishment and also the constitution of the academy itself. A chapter is then given to setting forth Franklin's ideas on education, followed by a comparison of his views with those of his eminent contemporaries, Adams and Jefferson. Franklin's theory of education was utilitarian, though not in the narrow, materialistic sense, and the University of Pennsylvania still shows, in its organization and its general spirit, the influence of his ideas. Rather more than half the present volume is devoted to a sketch of the university itself, the different departments of the subject being treated by different writers, a mode of treatment which makes the sketch rather scrappy, but gives, nevertheless, a fairly intelligible account of the institution. At the present time the number of students in the various medical and physiological departments outnumber all the rest, but there has been a movement at work for some years to broaden the scope of the university, and this movement, which has already led to the establishment of several new departments, gives promise of still better results in the future.

—The subjects to be brought before the International Congress of Anthropology, to be held at Chicago during the week beginning August 28, will be taken in the following order: Monday, Presidential Address, Physical Anthropology; Tuesday, Archæology; Wednesday, Ethnology; Thursday, Folk-Lore; Friday, Religions; Saturday, Linguistics. The morning proceedings will take place at the Memorial Art Palace, Michigan avenue and Adams street, and will commence each day at 9 A. M. At noon the meeting will adjourn for an afternoon session to be held at Jackson Park, at 2 P. M. At the afternoon meetings the papers to be read will have special reference to the anthropological exhibits at the Columbian Exposition, particularly those in the Anthropological Building, the U. S. Government Building, the foreign government buildings and the Midway Plaisance. It is proposed to visit the exhibits, after the reading of the papers, for inspection of the objects referred to. The following is the afternoon programme: Monday, Anthropological Laboratories; Tuesday, Folk-Lore; Wednesday, U. S. Government and Smithsonian Exhibits, Government Building; Thursday, American Archæology; Friday, Ethnology; Saturday, Ethnological Exhibits of Foreign Governments. The Midway Plaisance. The proceedings of the congress will be published in due course, and will consist of such papers, in full or in abstract, as shall have been formally presented to the congress, and be recommended for publication by a committee appointed for that purpose. A subscription of five dollars ($5.00) will entitle the subscriber to a copy of the volume to be published. Address all communications: Mr. C. Staniland Wake, Local Secretary, Department of Ethnology, World's Columbian Exposition, Chicago.

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

A GEOLOGICAL SKETCH, WITH NOTES ON THE GEOLOGY OF THE MANITOU ISLANDS OF LAKE NIPISSING, ONTARIO.

BY J. M. GOODWILLIE, OTTAWA, CANADA.

Geology is that particular branch of scientific study which treats of the history of the earth; its organization and structure, the materials of which it is composed and the various processes by which it has attained its present constitution.

The term Geology is derived from two Greek words: ge, the earth, and logos, a history or description.

As history, we must consider it apart from the records of human action and human progress,—a history disclosed to us by the record and study of the rock masses which lie around us and beneath us, and by comparing the results of the natural phenomena of the past with the numerous forces and agencies at present in operation, in modifying the surface of the globe.

By the term *rock*, in geology, is not to be understood merely that hard material which we commonly call stone, but it is employed to include everything of which the earth's crust is composed. The sand and gravel of our lake shores, the clays employed in the manufacture of brick and earthenware, the limestone and marble and sandstone of our provincial quarries, the pebbles and bowlders by the roadside, and the soil of which our gardens and farms are composed are all, geologically speaking, rock, equally with the granite of our hills and mountains.

The determination of the materials of which rocks are composed belongs to the department of mineralogy and which, although not identical with geology, is closely allied to it.

Geology endeavors to account for the rock masses and various materials of which the earth is constructed. It aims at answering the enquiry, how have these things been formed and what are the processes by which they exist? Mineralogy examines into the nature and character of the materials, and analyzes and resolves into its component parts the various ingredients of which a rock is composed.

The study of geology reveals the fact almost everywhere patent in our surroundings, that we live in the midst of a rocky area, which upon investigation, proves to belong to the oldest known rocks in existence, and forms what we might term the foundation stones of the superstructure of our world.

Mineralogy shows us what the rocks contain, whether iron, or copper, or galena, or nickel, or silver, or gold, or platinum, and the modes of their occurrence; so that by a careful study of the conditions in which they are usually found, the investigator and prospector may be saved much unnecessary expenditure of time and labor in searching after the concealed wealth which lies hidden from the easy observation of man.

Geology does not attempt to account for the origin of the world, but the careful study of it gives us the only intelligible solution that can be entertained of the causes which must have operated in producing its present appearance, and the diversity everywhere apparent in its structure.

To a higher than any human source must we look for an answer to the inquiry into the origin of the world. In the sublime and indisputable declaration with which the book of Divine Revelation opens, there is given us the only satisfactory answer that can anywhere be found and which must forever prove sufficient, not only as it relates to this terrestrial sphere, but also to the universe of unenumerated worlds of which this earth is, comparatively speaking, only an insignificant part: "In the beginning God created the heavens and the earth."

In that opening announcement of the book of God we are not only carried back to an indefinite, and it might be said an almost unlimited period, but we are also reminded that He who by his own almighty word "spake and it was done," and "commanded and it stood fast," did not then create the world as it at present exists. We are reminded that there was a time when the earth was without a human inhabitant, when no rain had yet fallen upon it, and when "there was not a man to till the ground." There was a time, further back, when our forests were uninhabited by wild beasts, and our marshes and lowlands untenanted by the almost numberless creeping things which make these resorts their abode. There was a time, still further back, when our streams and lakes and seas were without inhabitant, when there were no monarchs of the deep to engage in bloody encounters, and contest with each other the right of occupancy, and when there was no fowl of any kind to fly in the heavens, nor songsters to awaken the morning with notes of rejoicing and triumph.

There was a time, yet more distant, when the earth was destitute of vegetation of any kind, when no forests clothed our hills and mountains, when no grasses grew upon our plains, nor made verdant the valleys of our water courses, and when herbs, and fruits and flowers had not yet begun an existence preparatory to the introduction of animals and of man in particular.

There was a time, still more remote, when no mountain chains existed, with here and there lofty peaks penetrating the clouds and towering high towards heaven, and when there were no hills with accompanying valleys hollowed out among them.

There was a time, more distant still, when the earth appeared as one vast expanse of boundless sea, when islands and continents had not appeared above the surface of the great and mighty ocean, when "darkness was upon the face of the deep," and when, in all the illimitable dreary waste of waters, life and animation were entirely unknown.

Step by step the Creator was gradually preparing the earth to be the residence of the human race. Slowly and deliberately He brought about the necessary changes, all of whose workings are particularly distinguished by the absence of that spirit of haste and restless impatience so commonly manifested in the undertakings of man.

The time occupied in bringing about the present condition of things, as apparent throughout the world, must have been an indefinitely long period. Sacred science, as held and interpreted by the early Fathers, taught that the world was of a comparatively recent origin, and did not date beyond four or five thousand years before the Christian era, and that the time occupied in the act of creation comprised six ordinary days.

Geological investigation, however, constrains us to assign to the earth an antiquity much more remote than the six or seven thousand years which it is commonly supposed to have existed, and to give to the several stages which marked its gradual development a limit beyond the twenty-four hours included in each of the successive days of creation.

It is impossible, however, for us to arrive at any definite conclusion as to the age of the world. Scientists, anxious and zealous in the maintenance of truth, differ among themselves as to the exact time occupied in the various modifications which the world must necessarily have undergone previous to its being occupied as the temporary abode of man. Instead of a few thousand, the space included comprises tens of thousands of years; some estimating the time at fifty thousand, others at two hundred and fifty thousand, and half a million of years as being necessary to the production of the present condition of things. But in one particular they all agree, and unite in giving to the earth a place in history many thousands of years anterior to the creation of man.

The rocks of which the earth's crust is composed are divided into 1st, igneous, or eruptive and unstratified rocks, and 2d, aqueous, or sedimentary and stratified rocks.

A third division is sometimes made and designated as metamorphic rocks, or rocks of a stratified crystalline formation, which in reality are only sedimentary rocks which have been changed by the action of steam or heat without destroying their stratified appearance.

By far the largest proportion of the earth's crust with which the geologist has to do is composed of aqueous or sedimentary and stratified rocks, and to the study of these, principally, must we look for those facts and data which, without doubt, prove our world to have a history of very great and undetermined antiquity.

By the crust of the earth is to be understood the materials of these several great sub-divisions of which the earth's surface is composed. It is by no means to be regarded as a solid mass throughout. Different theories have been advanced by scientists in reference to the internal condition of the earth. Some consider the centre of the earth to be composed of rock matter solidified by pressure with liquid fiery matter between this central area and the crust on the surface.

Others regard the earth as more or less solid, with lakes and seas of fire internally alternating throughout, while many others, and the commonly received opinion, hold that beneath the surface, of which we are accustomed to speak as the crust of the earth, and which extends to only a very limited depth, the whole of the internal portion of the earth consists of a molten sea of liquid fire.

The evidence in favor of this is confirmed by the following observations: In various parts of the world and at certain depths below the surface, an even temperature is found to exist throughout the year. At greater depths the temperature invariably increases, and although in all places it is not uniform, owing to the different kinds of rock penetrated, the average rate of increase is one degree for every sixty feet. And, as we may reasonably suppose the ratio to increase the greater the depth attained, we might expect comparatively soon to reach a temperature sufficiently high to sustain most minerals in a vaporous or molten condition.

Another evidence is found in the fact, that water brought at great depths from beneath the surface is found to possess a higher temperature than the temperature of the surrounding locality, and if the depth be extended the temperature of the water is increased with it.

Another and more convincing argument in proof of the molten condition of the interior of the earth is afforded us by the numerous volcanoes which occur throughout the world, some of which have been in active operation for hundreds, and even thousands, of years. They are generally regarded as constituting the principal channels of communication between the interior parts of the earth and the surface; and from unfathomable depths are more or less constantly pouring forth immense volumes of molten rock and liquid streams of living fire. More than two hundred and fifty volcanoes are now known at different times to be in a state of eruption, and many others have long since ceased to exhibit any degree of activity.

The thickness of the earth's crust has been variously estimated at from ten to twenty miles and upwards, but there is no means by which the exact depth of rock matter upon the surface can be accurately determined.

From the above considerations we are led to the conclusion that the interior of the earth consists of a mass of igneous incandescent matter, and which may have been, originally, the condition of the material now forming the crust of the earth, and that the gradual cooling of the surface by radiation, accompanied by the shrinkage and contraction attending the cooling process, together with the enormous pressure from within, produced immense crackings and bulgings of the earth's crust, which resulted in the many groups and chains of mountains, and associated valleys, to be seen upon the surface.

The rocks surrounding Lake Nipissing belong to the oldest known rocks in existence. They are the lowest and first in the order of sequence, and with but one exception, so far as is known, are almost entirely of an eruptive or metamorphic origin. They belong to the great Laurentian formation which extends over all the northern portions of the provinces of Quebec and Ontario, and continues west and northward to the Arctic Ocean. They are usually distinguished by their inclination at high angles, and by presenting in many places a variously folded and contorted appearance, and by the absence of organic remains. Here and there they are broken through by fragments and hugh masses of granite, which in some instances appear to have become the centres of eddies or whirlpools of molten rock. Some very interesting examples of these may be seen on the high, rocky portion crossed by McIntyre Street in the southeast part of the town of North Bay.

During some period of the world's history this whole region has undergone a most terrific convulsion of upheaval and depression, during which streams and lakes of fire appeared upon the surface, liquefying and changing the condition of the rock masses with which they came in contact.

To this same period, and to the operation of these same agencies, must we trace the origin of the extensive mineral deposits which occur throughout this northern region. The various metals being more fusible than the rock masses in general, found a ready exit in the cracks and fissures formed by the breaking of the earth's crust, and filling these became subsequently cooled, forming veins of various depths and thicknesses, and sometimes extending for miles in length, imparting to this part of our dominion, in outward appearance so uninviting, an attractiveness of wealth, in mineral resources, unrivalled, and perhaps it would not be an exaggeration to say, unequalled by any country in the world.

The rocks forming the second great sub-division into which the crust of the earth is divided are called aqueous, or sedimentary rocks. They are essentially formed by the action of water, the strata or layers of which they are composed varying in composition and thickness according to the mineral character of the water and sediments, and the length of time engaged in forming them. They are readily distinguished from igneous, or eruptive rocks, by their horizontally stratified appearance, and by the occurrence of organic remains, of which some strata are almost wholly composed. These remains, which we commonly call fossils, comprise almost every variety of vegetable and animal life of the past, from the lowest fungus to the highest form of animate creation, including also many extinct species of both plants and animals, and which have no living representatives in the types and genera of the present day.

An examination into the nature and character of these fossil remains, both of vegetables and animals, which have inhabited the globe during the periods of its past history, constitutes the science of palæontology.

The sedimentary rocks, which enter so largely into the formation of the earth's surface, comprise a number of great divisions, distinguished by special and characteristic collections of plants and animals, and these again are further sub-divided, each sub-division having fossils peculiar to itself, and which may easily be recognized by those skilled in palæontology.

We shall have a clear understanding of the manner in which sedimentary rocks were formed by observing the various natural processes in operation at the present time in modifying the surface of the globe.

Sediments of various kinds, such as sand and gravel, and clays in solution, are constantly being carried down by streams and rivers and deposited on the bottom of lakes and seas.

Portions of banks and cliffs on the sea coast are continually breaking away, and, by the action of the water, disintegrated and spread over the bottom. The sediment deposited in this way is generally found to be disposed in horizontally arranged beds or layers, often enclosing shells and bones, weeds, leaves and branches from trees, and other organic bodies, drifted from the land or carried by the various streams into the sea. In process of time the sediments so deposited become solidified, partly by means of the calcareous and silicious matter contained in them, and that derived from the decomposition of the enclosed organic remains, and partly by the pressure of the superincumbent layers and strata of sedimentary matter.

In this and similar ways, all the stratified rocks on the surface of the globe have at different periods been built up, enclosing within the various formations the almost innumerable forms of vegetable and animal life peculiar to each successive period.

The time occupied in the deposition and solidifying of stratified rocks must necessarily have been enormously great.

It would not be an exaggeration to say that tens of thousands of years would be requisite to bring about the results which are so apparent in all our stratified rock formations.

The coast line of the Gulf of Mexico, at the mouth of the Mississippi River, has been known for more than three hundred years; and notwithstanding the immense alluvial deposits annually conveyed to the sea by that river and its tributaries for more than three centuries, comparatively little change has been made by the encroachment of the land upon the sea, and yet there was doubtless a time when the delta of the Mississippi was at St. Louis, nearly eight hundred miles from its present position.

Another and more forcible illustration may be seen in the various coal fields of the present day. They appear to have consisted, originally, of primeval forests, situated in low or marshy ground, which by a sinking of the earth's crust, or some similar natural phenomenon, gradually became submerged, and eventually covered with organic sediment of a vegetable kind, and in this condition have been gradually consolidated. In process of time fresh forests appear to have grown up, covering the same area, and in turn have in a like manner disappeared beneath the surface. In the coal-bearing strata of Nova Scotia, which have attained a thickness of 14,570 feet, no less than seventeen successive forests have been counted in less than one-third of that depth. Trees four feet in diameter have been found standing erect and almost entire, as they originally grew upon the surface. In the coal field of Sydney fifty-nine fossil forests have been distinctly traced, one above another.

When we take into consideration the time necessary to mature the growth of a forest, the gradual subsidence of the area on which it grew, until the whole was completely submerged, the filling up of the area with decomposed organic matter, the formation and growth of a second forest similar to its predecessor, and so on until fifty-nine such forests have matured and in turn disappeared, we can form some idea, though very vague at best, of the vast extent of time occupied in fitting up this world as an abode for man.

Again, when we consider that many stratified rocks lie hundreds and thousands of feet above the level of the sea, that the various strata of which they are composed abound in the fossilized remains of marine shells and animals, that there was a time when these same rocks must have formed the bed of the ocean, and the substratum of numerous other strata ages since abraded from their surface, not only will our conceptions of the length of time the earth has existed be greatly enlarged, but rightly considered, we shall also be led to adore the unsearchable wisdom and mighty power by which all these things were made.

A study of the geology of the Manitou Islands lying in front of North Bay reveals the only exceptional break in all the Laurentian monotony of this district. There, side by side with rocks of the Laurentian sea, we have presented, in clearly defined outlines, substantial evidences of stratified rock formation belonging to what is commonly known as the Trenton period, which is only one of the great sub-divisions of the Palæozic age of the earth's history.

At some time very remote, when this whole region was in the throes of convulsion, when livid streams of molten rock broke forth from beneath, and fire and heat and steam acting in concert aided the work of disintegration, when huge masses of metamorphosed and igneous rock matter were heterogeneously piled into the hills and mountains round about, and when by an unevenly formed subsidence of the earth's crust an immense valley was constituted, now occupied by the waters of Lake Nipissing, amid the wreck of matter and the chaos and confusion that reigned on every hand, a portion of Little Manitou remained undisturbed, retaining in an unchanged condition, in its argillaceous and bitumenous shales and calcareous strata, abundant organic remains of both animal and vegetable life, the internal evidence of its own antiquity.

On Great Manitou Island similar evidences exist, but under somewhat changed conditions. There are outcroppings of stratified rock on both the eastern and the western divisions of the island. That on the eastern part of the island apparently corresponds in strike with the exposure on Little Manitou, but appears to have a slight dip to the south or southwest. The whole area, however, is so obscured with drift and bowlders that neither dip nor strike can be determined with any degree of accuracy.

On the western part of the island, where the principal exposure occurs, the strata have a dip of twenty-two degrees to the southwest, reminding us that during the period of upheaval through which this district passed, Great Manitou by no means fared so well as its sister island.

On the third largest island of the group there are also indications of a stratified formation, but in this case, as in the other referred to, the whole is so covered with drift and rubbish and densely wooded as to render it at present practically indeterminable.

The islands are not only conveniently and pleasantly situated, but are also one of the most delightful and healthful summer resorts in this whole northern region. The student of geology will always find a seasonable visit to these islands a delightful pastime, and will be amply rewarded in being afforded an opportunity of studying some features of geological science seldom experienced, and which assist us materially in correctly interpreting the past history of the earth. Some of the fossils found on the islands are in themselves interesting objects of study, and beautiful illustrations of that wisdom and skill everywhere to be seen in the Creator's work. And while they are important as evidences of past history and assist in determining to some extent the very great age of our world, they are also no less significant in demonstrating the eternity of Him who "before the mountains were brought forth, or ever the earth and the world were formed," from everlasting to everlasting is God.

In contemplating the glory and grandeur of the Creative handiwork, and considering the great antiquity of the world on which we dwell, may we not well adopt the language of inspiration and say: "Great and marvellous are thy works, Lord God Almighty;" "Of old hast thou laid the foundations of the earth."

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The 42nd meeting of the American Association opened at Madison, Wisconsin, on August 17th. The following were the officers of the meeting, new secretaries having to be elected in the case of Sections E and G, Messrs. Hill and Coville being absent on the opening of the meeting: President, William Harkness, Washington, D. C.; Vice Presidents.—A. Mathematics and Astronomy—C. L. Doolittle, South Bethlehem, Pa. B. Physics—E. L. Nichols, Ithaca, N. Y. C. Chemistry—Edward Hart, Easton, Pa. D. Mechanical Science and Engineering—S. W. Robinson, Columbus, O. E. Geology and Geography—Chas. D. Walcott, Washington, D. C. F. Zoölogy—Henry F. Osborn, New York, N. Y. G. Botany—Charles E. Bessey, Lincoln, Neb. H. Anthropology—J. Owen Dorsey, Tacoma Park, Md. I. Economic Science and Statistics—William H. Brewer, New Haven, Conn. Permanent Secretary, F. W. Putnam, Cambridge (office Salem), Mass. General Secretary, T. H. Norton, Cincinnati, Ohio. Secretary of the Council, H. L. Fairchild, Rochester, N. Y. Secretaries of the Sections. A. Mathematics and Astronomy—C. A. Waldo, Newcastle, Ind. B. Physics—W. LeConte Stevens, Troy, N. Y. C. Chemistry—H. N. Stokes, Chicago, Ill. D. Mechanical Science and Engineering—D. S. Jacobus, Hoboken, N. J. E. Geology and Geography—W. H. Hobbs, Madison, Wis. F. Zoölogy—L. O. Howard, Washington, D. C. G. Botany—B. T. Galloway, Washington, D. C. H. Anthropology—Warren K. Moorehead, Xenia, O. I. Economic Science and Statistics—Nellie S. Kedzie, Manhattan, Kan. Treasurer, William Lilly, Mauch Chunk, Pa.

The addresses of the Vice Presidents were delivered before their respective sections in the afternoon, and they were as follows: Vice President Nichols, before Section of Physics; subject, "Phenomena of the Time Infinitesimal." Vice President Dorsey, before Section of Anthropology; subject, "The Biloxi Indians of Louisiana." Vice President Walcott, before Section of Geology and Geography; subject, "Geologic Time as Indicated by the Sedimentary Rocks of North America." Vice President Brewer, before Section of Economic Science and Statistics; subject, "The Mutual Relations of Science and Stock-Breeding." Vice President Osborn, before Section of Zoölogy; subject, "The Rise of the Mammalia." Vice President Doolittle, before Section of Mathematics and Astronomy; subject, "Variations of Latitude." Vice President Bessey, before section of Botany; subject, "Evolution and Classification." Vice President Hart, before Section of Chemistry; subject, "Twenty-five Years' Progress in Analytical Chemistry." Vice President Robinson, before Section of Mechanical Science and Engineering; subject, "Training in Engineering Science."

Vice President Walcott in his address before Section E, Geology, referred to the various estimates that had been made as to the length of geological time, these varying from a minimum of 3,000,000 to a maximum of 1,200,000,000 years. His own studies, based largely upon the Paleozoic sediments of the Cordilleran area, gave a mean between these. The following table gives the estimated time for each of the larger geological eras:

Cænozoic,	2,900,000
Mesozoic,	7,240,000
Paleozoic,	17,500,000
Algonkian,	17,500,000
Archean,	?
Total,	$45,140,000

He stated his belief in the theory that the deep seas and the continental areas are permanent, and thought that the main outlines of the North American continent were laid down as far back as Archean time. Cambrian sediments on either side of the continent are of such extent as to justify the belief, or rather necessitate the belief, that extensive continental masses were near at hand. Thirty thousand feet of sediment in the Rocky Mountain area, and nearly as much in the Appalachian, were indicative of long lapses of time. The sediments of the Rocky Mountains were deposited over an area of at least 400,000 square miles and probably of 800,000. This area extended from the Gulf of Mexico to the Arctic Ocean.

Many statements were made as to the rate of denudation and deposition of calcareous and mechanical sediments. Estimated at the rate of deposit of calcareous sediments now being formed, it was calculated that about 600,000 years would be required to form a deposit of limestone twenty-two feet in thickness. It was estimated that about 47,000,000 years would be required, at this rate, to form the deposit of calcium carbonate in the Cordilleran area. But reducing this fifty per cent for any possible change of conditions, and then taking off a further twenty-five per cent for special conditions affecting deposition, 16,000,000 years would remain for the accumulation of the calcareous sediments. To this must be added time for mechanical deposits, and putting this at its lowest possible term of 1,500,000 years, we have the 17,500,000 years for the Paleozoic time given above.

Professor Osborn, in addressing Section F upon the rise of the mammalia, dwelt especially upon the methods employed by paleontologists, and upon the broad generalizations that had been made by students of fossil mammals. Among these was the generalization of Marsh, that all early types of mammalia had small brain cavities.

Cope had shown by the growth of the feet that all early types had five toes upon both the fore and hind feet and that the foot rested upon the sole. He had also shown that while the primitive types possessed cone-shaped teeth, the more differentiated they became the more complex the teeth were. An interesting statement in regard to the dental formulas of various orders was given. Without going into details, it may be said that the speaker argued for the three great groups of mammals,—monotremes, marsupials and placentals,—a common origin far back of Jurassic times, for the three were then plainly differentiated. These classes arose from a promammalian type, which was, in its turn, an offshoot from a still simpler form, a second offshoot from which developed into the reptilian type of life. The horse he considered as originating on the North American continent, and he pointed out the interesting fact that the disappearance of many of the huge forms of mammals that once peopled our western plains seemed co-incident with the introduction of grasses.

Professor Bessey, before Section G (Botany), gave an excellent address upon classification. He pointed out the anomalous fact that while botanists have long recognized that the present scheme of classification was defective, they still adhered to it. Theoretically discarding it, practically they used it. He showed that there may be degradation as well as advancement in evolution, and that what seemed the lowest forms of dicotyledons, from their floral structure, were not necessarily primitive types. He therefore interpolated the apetalous orders of the ordinary classifications among the polypetalæ, as degraded types of polypetalous flowers. He outlined what seemed to him to be a natural classification, considering the Ranunculaceæ as the most primitive flowers. The greatest deviation, therefore, from this type was the highest in organization. He believed that with but little modification the sequence of orders in our modern text books could be used to express the natural relationships of plants. Of course such a scheme as a lineal arrangement was out of the question. He, in common with many others, recognized the Compositæ as the most highly organized of the dicotyledons, and the Orchideæ were placed at the head of the monocotyledons.

In the general session of Thursday evening the retiring president, Professor LeConte, of California, delivered an address upon the "Origin of Mountains." In opening, he defined a mountain as the result of a single earth effort, occupying a short or a very long time, while a mountain range was the result of a succession of earth throes. The thickness of the strata of mountains varies, but it is always great. In the Appalachians the Paleozoic is 40,000 feet thick. The Mesozoic of the Alps is 50,000 feet, and the Cretaceous of California is 20,000 feet. The sediments of the Appalachians thin out to the west to only one or two thousand feet, so that mountains may be considered as lines of exceptionally thick sediments. They are, at the same time, lines of exceptionally coarse sediments. Foldings and faults are also characteristic of these features of the earth, the folds being single or many, and the faults being sometimes of enormous extent. Faults of 20,000 feet occur in our western region. After this general discussion of features, the causes were considered. There are both formal and physical explanations. The first explain the cause from the geologists' point of view, and the second from that of the physicist. The first may explain one or more of the phenomena, but the last must explain all of them. Various illustrations were given of these, and then the formal explanation of facts was taken up. Mountains are born of sea-margin deposits, the loaded sea bottoms inducing sinking of the denuded land surface, and the mountains are formed by lateral crushing and upthrust. He did not believe in the theory of a liquid interior, with a solid crust, stating that a globe as solid as glass or steel would assume the oblate spheroid form, as the result of rotation. He argued at length in favor of the lateral thrust origin of mountains, and examined objections urged against it. He also outlined other theories of mountain origin, and pointed out their defects, declaring, however, his entire willingness to give up his theory whenever any better one had been presented.

THE CORNELL MIXTURE.

BY M. V. SLINGERLAND, CORNELL EXPERIMENT STATION, ITHACA, N. Y.

Last winter, while experimenting in the making of the different insecticides and fungicides, I succeeded in forming a combination which, at the time, seemed to be an almost perfect panacea for all the insect and fungoid ills that might affect the fruit grower. When it was shown to Professor Bailey he immediately dubbed it "The Cornell Compound or Mixture."

In making the mixture I combined the following well-known insecticides and fungicides: Paris green, kerosene emulsion and Bordeaux mixture. Simple enough, was it not? And what a field of possibilities and probabilities it seemed to cover when the theory of the combination is rightly understood. In the Paris green (which I prefer to London purple, on account of its containing less soluble arsenic, and is thus less liable to injure tender foliage, and still better, the copper of the Paris green gives it noticeable fungicidal properties) we have the best, cheapest and most practicable insecticide for all biting or chewing insects like the codlin moth, the potato beetle, and all the leaf-eating caterpillars and beetles. The kerosene emulsion is also well known as the best, cheapest and most practicable insecticide for general use against all insects which obtain their food by sucking it through slender beaks with which they pierce the tissues of the plant. Familiar examples of this group of insects are the pear psylla, the plant-lice and the squash bug. And finally, the Bordeau mixture, which now ranks first among the fungicides in effectiveness against the worst fungoid diseases, like the apple scab, the potato blight and rot, and the plum and peach fruit rot. One can thus understand what a destructive power there seemed to lurk behind the mask of the Cornell mixture.

Many experimenters have shown that when the Bordeaux and Paris green are combined, the destructive effect of neither is lessened, and we know that the lime of the Bordeaux mixture converts all of the soluble arsenic of the Paris green into an insoluble compound, thus allowing the use of the arsenite at nearly twice the strength usually used without danger to tender foliage. The two are easily combined and are to be recommended for general use.

Attempts have been made to combine the insecticides Paris green for biting insects, and kerosene emulsion for sucking insects, but without success; the arsenite cannot be made to unite satisfactorily with the oily lighter emulsion. I have seen no accounts of any trials to combine the Bordeaux mixture with kerosene emulsion. Such a combination strongly recommends itself to pear growers especially, who have the pear psylla to fight, and who wish to exterminate the scab at the same time. My experiments in this line were suggested by a large pear grower who had these foes to meet.

My Bordeaux and emulsion were made according to the directions which are appended below.* When the directions were carefully followed I found that I could quite readily combine the two in any proportions required, and the resulting mixture remained stable for weeks; and in fact the Bordeaux, as a mechanical mixture, was improved, for the emulsion held the lime in suspension, so that its tendency to settle to the bottom, and thus require constant stirring, was reduced to a minimum. The addition of the Paris green to the Bordeaux before the emulsion was put in did not visibly affect the mixture. Up to this point, therefore, the combination was a success. It now remained to be seen how it would stand a practical test by the ordinary fruit grower in the field. Theoretically, the chances were all in its favor.

However, further experimentation at the Insectary showed that unless the Bordeaux was rightly made, the emulsion would not form a stable combination with it, and in fact sometimes would scarcely mix at all. It was found that the best combination was obtained when the acid copper sulphate solution of the Bordeaux was exactly neutralized by the alkaline lime; the potassium ferrocyanide was the test to determine when this point was reached. Thus, when the Bordeaux was made in the usual way without testing, nine times out of ten the emulsion would not mix with it satisfactorily. Here, then, was the first obstacle to the Cornell mixture,—the difficulty of making it.

In the spring I saw it made and applied on a large scale, with horse power sprayers. As far as the making and application were concerned, it was a success. It worked as easily through the sprayer and nozzle as the Bordeaux alone. But an examination of the trees after the sprayer had passed showed that the mixture had not spread so evenly over the tree as would either of the ingredients alone. And right here, I believe, is the weakest point in the Cornell mixture. The spray was thrown fine enough, but when it struck the trees the minute particles seemed to be drawn together into larger oily drops, leaving considerable areas unwet. There is a tendency in the Bordeaux mixture alone to do this, but it was increased by the oil in the emulsion.

One can easily imagine with what regret I am thus obliged to tear the mask from off my theoretically complete panacea. When first concocted it seemed equal to all that might be claimed for it, and it was thought best to publish it at once; but, realizing that it ought to be first fully tested in a practical manner, it was put into the hands of two or three large fruit growers with the results which I have detailed above. On the whole, the Cornell mixture, *theoretically*, has great possibilities, and in the hands of careful men can be made, but for the ordinary fruit grower or farmer the difficulty of making it will render it impracticable. And when properly made and applied it will be quite effective, each ingredient for the purpose it is intended. But I believe the effectiveness of each ingredient will be greater if they are not applied in combination, but singly. Thus, theoretically, the Cornell mixture has great possibilities, but, besides the difficulty of making, the effectiveness of each ingredient is lessened, and in consequence the practicability of the mixture is as yet doubtful, and I cannot freely recommend it for general use.

*To make the Bordeaux mixture, dissolve six pounds of sulphate of copper in four or five gallons of hot water. Slake four pounds of quick lime in sufficient water to form a thin whitewash and strain this through a gunny sack (burlap) into the copper sulphate solution. Dilute to forty gallons with water, and the mixture is ready for use. When using, it must be kept thoroughly stirred to keep the lime in suspension. The preparation of the mixture in large quantities may be simplified by a test which obviates the necessity of weighing the lime. Keep the mixture thoroughly stirred when the thin whitewash of slaked lime is being poured through the burlap, and add from time to time a drop or two of the commercial potassium ferrocyanide to the mixture. If not enough lime has been added the drop of ferrocyanide will turn to a very dark color the moment it touches the mixture; when enough lime has been added, the ferrocyanide will not change color when it is dropped into the mixture.

To make the emulsion, thoroughly dissolve one-half pound hard or soft soap in one gallon boiling water. While this solution is still very hot add two gallons of kerosene and quickly begin to agitate the whole mass through a syringe or force-pump, drawing the liquid into the pump and forcing it back into the dish. Continue this for five minutes, or until the whole mass assumes a creamy color and consistency which will adhere to the sides of the vessel, and not glide off like oil. It may now be readily diluted with cold rain water, or the whole mass may be allowed to cool when it has a semi-solid form, not unlike loppered milk. This standard emulsion, if covered and placed in a cool dark place, will keep for a long time. In making a dilution from this cold emulsion, it is necessary to dissolve the amount required in three or four parts of boiling water, after which cold rain water may be dded in the required quantities.

CHEMISTRY IN CANE SUGAR MANUFACTURE.

BY J. T. CRAWLEY, SUGARLAND, TEXAS.

During recent years the part played by chemistry in the manufacture of sugar from the sugar cane has become an important one, cane sugar manufacture is older than beet sugar manufacture, but it remained for those interested in the latter to work out the practical and scientific questions that make the industry of such vast importance at the present time. It is only in recent years that the same scientific principles have been applied in tropical countries in the field and in the factory. Important among the recent improvements has been the application of chemistry to the better understanding of the various changes that the raw material may undergo while being converted into refined products.

When the cane is brought from the fields it is weighed, and then, in most cases, is passed between immense iron rollers where the juice is expressed. By recent improvements in mills the per cent of juice actually obtained, has increased from the neighborhood of 65 per cent to from 75 to 80 per cent.

This great improvement has been made of course by the engineer, but it is safe to say that without the aid of the chemist in calling attention to the immense losses in the bagasse these improvements would have been delayed many years.

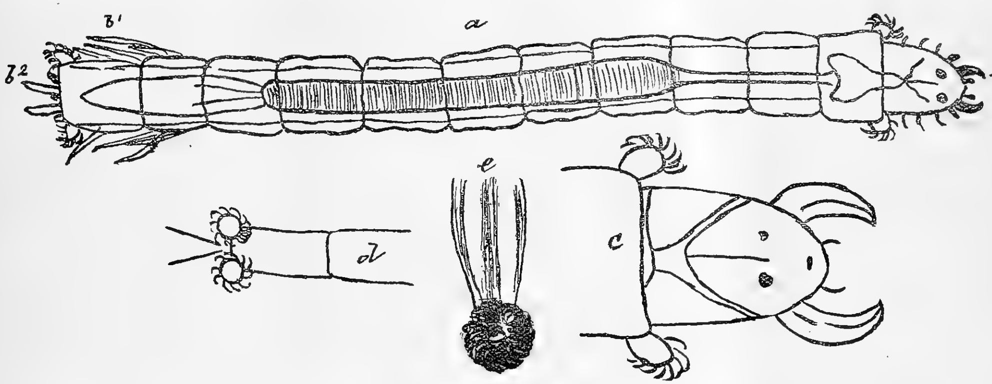
After expression the juice is either weighed or measured and then the real work of chemistry begins. Because of the changes that the contained sucrose may undergo during subsequent processes the juice is analysed for sucrose, glucose, total solids, ratio of sucrose to glucose and ratio of sucrose to the total solid matter. This gives, by proper calculations, the total amount of the various ingredients entering the factory with the various ratios one to the other. These ingredients with their ratios must be watched very closely to see that impurities are not formed at the expense of the cane sugar. Lime is added to the raw juice for the purpose of neutralizing the acids contained therein, and in order to purge it of many of the impurities that would interfere with the subsequent crystallization of sugar. Here again a strict watch must be kept. An insufficient quantity of lime leaves free acids in the juice and these same acids will act upon the sucrose changing it into glucose, or inverted sugar, during the evaporation of the juice and syrup. Analyses are made of clarified juice, syrup, massecuite, etc., and from these analyses together with the weights of these various products the chemist is enabled to detect any important loss that has been sustained, whether it be chemical or mechanical, and from a scientific examination of the data thus furnished the manufacturer is enabled to so modify the various processes as to get the best results, finally the sugar and molasses are analysed, and thus a complete record is had of the whole process from the entering of the cane to the final output of sugar and molasses. It will thus be seen that the chemist is the book-keeper, so to speak, of the sugar during the process of manufacture, and it is his business to point out losses, and, if possible, suggest remedies. It is a rare case, however, to find a factory in Louisiana where a strict chemical control, such as has here been outlined, is maintained.

The great amount of labor necessary, together with the cost of weighing and measuring apparatus, has prevented the majority of factories from adopting such a complete system as will tell them the efficiency of their work. But in these days of sharp competition the fact is gradually impressing itself that science must not be overlooked, and that it is of vast assistance even where money-making is the only end.

NOTES ON MARINE AND FRESH WATER LARVÆ OF MIDGES.

BY GEO. SWAINSON, F. L. S., ST. ANNE'S-ON-THE-SEA, ENG.

During the past two years Professor Miall, F. R. S., has been lecturing before the British Association and elsewhere on "Some difficulties in the life of aquatic insects," and especially instancing the larva of the dipterous fly *Chironomus.* My interest in this lecture when heard at Cardiff was heightened by the fact that I had on three occasions captured a marine larva very closely resembling his *chironomus.* This was included by Dr. Johnston amongst the British Marine Annelids under the name of *Campontia cruciformis.* (*London Mag. of Nat. Hist.*, Vol. 8, p. 179, Nov. 13, 1834, and "Johnston's British Worms."). That *campontia* was a dipterous larva was suspected by both McLeay and Green, the latter because he captured a fresh-water chironomus larva, and noticed its resemblance to *campontia*, and observed its metamorphose into the pupa stage, but the fly escaped him, and this fresh-water genus remained unspecified. This was in 1837, and since that time no one in England seems to have taken the trouble to find out *campontia's* fresh-water relations.



CAMPONTIA CRUCIFORMIS (A SUPPOSED ANNELID WORM).

a. Natural size.
b. Magnified.
c. The head slightly compressed between plates of glass.
d. Under side of the anal segment.
e. Hooked sucker foot from Mr. Swainson's microphotograph.

In October last, on our Golf links at St. Anne's-on-the-Sea, I found several larvæ of *chironomus* fully grown in its splendid blood-red color. These I kept during the winter, and watched their metamorphoses in small glass jars, with the tops covered with muslin. They ultimately proved to be *C. dorsalis*, and their resemblance to *Campontia cruciformis* in all but color is most remarkable. The hæmoglobin, which colors the blood plasma in the "Harlequin" larva so beautifully, is replaced in the marine form by a light sea-green pigment with which the fat cells are colored. The mandibles and two pairs of retractible hooked appendages, or pro-legs, are very similar to *C. dorsalis*, and especially the respiratory tubules at the posterior, and I had therefore no doubt as to *Campontia cruciformis* of Johnston being a dipterous larva of the *chironomus* genus. I found this larva several times on the obelia zoöphytes growing at the end of St. Anne's Pier, Lancashire, England. Next I found it on some coryne from the Mumbles, Swansea, and more recently I dredged it from fifteen fathoms depth off Spanish Head, Isle of Man, adhering to seaweed. Dr. Packard, of America, has recorded the discovery of a marine dipterous larva in fifteen fathoms off Salem Harbor, which he has named *Chironomus oceanicus* (see Transactions of Essex Institute, Vol. 6, p. 42). I have carefully compared my specimens with the drawings given by Dr. Packard, and it is quite certain they are not the same species, the mandibles being slightly different, but more particularly the hooklets or retractible claws on both the fore and hind feet are very different, and the respiratory tubules possessed by *campontia* are not visible on the American species.

The great difficulty I experienced in finding any one in England to assist in naming this and other species of chironomus larvæ I have met with, in a large measure prompted me to write this paper. I have applied to many of the principal authorities on diptera, only to find that there are several families in which the life history of only a very few species has been worked out. Surely there are many excellent members of our microscopical societies throughout England who only need to have the fact brought home to them to induce them to make some attempt, however feeble, to fill up this gap, especially as the subject is a very interesting one, and the material abundant. The difficulty of obtaining specialists to undertake the work of describing many groups of insects has been recently referred to by the editor of *Natural Science*, for he states that, though Mr. Whymper's "Travels amongst the Great Andes of the Equator" was completed twelve years ago, the volume in which the zoölogical collection was described, has been only recently issued, and this with several large groups of insects omitted, as no one has been found able to describe them. Professor Miall, to whom I sent my specimens, thought it would ultimately turn out that Johnston's *campontia* was Schiner's *Thalassomyia frauenfeldi.* This may prove to be so, but, again, Schiner only records the capture of the female fly and gives no account of the larvæ in his "Fauna Austriaca" (p. 596, Vol. 2). This species is British, for Mr. H. N. Ridley, of the British Museum, captured both the male and the female flies in a cave in the Isle of Wight (*Entomological Mag.* for 1884), and I think it is the same fly I have seen more than once on our pier end at St. Anne's-on-the-Sea, but did not succeed in capturing them. There is no drawing published yet, I believe, of *Thalassomyia frauenfeldi.* I have twice tried to rear *Campontia cruciformis* in a small salt-water aquarium, but unsuccessfully. It seems quite certain that the larvæ of these diptera do inhabit salt water, for Agassiz speaks of them in the "Cruises of the Blake" as being commonly met with off the North American shores.

Leaving these species for future identification, I must now record the discovery of three species of the larva of the fresh-water *chironomus* new to science, and drawings of which accompany these notes, together with that of another new form found only last week by my friend Mr. A. R. Hammond, F. L. S., on the leaves of potamogeton, forming small tunnels therein. I have made a few mounts of all these species, which will very likely prove to be larvæ of well-known species of flies described by Walker and listed by Verrall, there being over 250 different species of chironomidæ in Britain, while the larvæ of only some dozen are known. Up to the present time the best work on these and similar "eucaphalous" larvæ is that of Prof. F. Meinert, published by the Royal Society of Copenhagen in 1886, full of splendid plates of the larvæ only of fresh-water species, but it is in Danish, and I do not know that it has been translated. None of these new specimens are included therein, and Mr. Hammond, who is well up in the bibliography (he is now bringing out a paper in the transactions in the Linnean Society and shortly to be published on the structure and life history of *Chironomus dorsalis*, in collaboration with Professor Miall), informs me that he has not met with any drawings or description of these larvæ of mine. I may add that Dr. Johnston's drawing of *campontia* does not show the two pairs of long respiratory tubules which the larva can protrude from the eleventh segment and retract again. These are, however, shown very clearly in the micro-photographs of my mounts of *campontia* and *Chironomus dorsalis.* Mr. Slater describes these as being also seen in *C. plumosis* (Ent. XII., p. 87). They are clearly shown in Meinert's drawings as possessed by *C. plumosis* and also by *C. venustus*, but this latter is believed to be the same species as *C. dorsalis.*

In conclusion, I must not omit to make a note of what I feel sure is an instance of the very interesting development known as *parthenogenesis* in connection with *C. dorsalis.* One of the larvæ, fully grown, was put in a bottle late in October, 1891. It sickened and died, but before its death there came forth from the body a large number of young *C. dorsalis,* which ultimately became fully developed, though not so large as the other imagenes. The bottle containing them was in a cold room, and they all appeared in the winter before the end of February, and so could not possibly be hatched from eggs laid prior to October. I watched these most sedulously through the pupa state, for they spun their pupa cells on the under side of leaves, and not in the mud at the bottom of the glass, like the ordinary *Chironomus dorsalis,* waving their heads about in the curious way described by Meinert. They did not assume the strong, deep, blood-red color either, being nearer the surface of the water. There is no question about the flies being *C. dorsalis,* as I have now one or two in spirits of wine. Finding that Mr. Oscar von Grimm had recorded the fact that the pupa of *chironomus* laid eggs prepared in the body of the larva, these ova being deposited in rows of long threads, just as the female *C. dorsalis* does, only that they are protruded through two small holes above the anus of the pupa. I therefore watched the older non-parthenogenetic blood worms most carefully, when they emerged from the larval into the pupal state, and I must say, that never did the proceeding take place, as far as I could see, and during the following month there were no young larva of *Chironomus dorsalis* produced. It is quite evident that further investigation and the closer watching of the life history of these midges will fully repay entomologists, for it is hardly possible to think, after Mr. Grimm's careful and detailed investigations, that his young larvæ were parthenogenetically produced.

LETTERS TO THE EDITOR.

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

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

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

A Space-relation of Numbers.

Mr. D. S. Martin's article under this head, in *Science* for August 11, is of peculiar interest to me in touching upon a mind experience which I had supposed an idiosyncrasy of my own, since I have been unable to find another person who had any similar experience, except my own mother. I am glad to find another person of a like mind, since it is an indication that it may not be an exceedingly rare experience.

I date the origin of my idea at the time when I began to learn to count, which was at home, by the "purely abstract and *memoriter*" system. Not only are the numbers from 1 to 100, but from 1 to infinity, and all the fractions in a less degree, conceived of by me "as holding, relatively, definite positions in space, from which they never vary." It is simply impossible for me to think of a number except in its relation to the other numbers and in its position in the scheme.

In my mind the numerical position bears no relation to that of any other object or thing, nor to the position of my body; but it does bear a definite relation to the points of the compass. Beginning at my feet the numbers 1 to 10 run due west in a slightly ascending line, 10 being a little beyond and above 9, with 5 above and beyond 4 so that it is given greater prominence. 10, 11 and 12 are arranged in an ascending spiral. 12 is above the plane of 1 say six inches. 12 to 15 are in a horizontal plane in a straight line running W. N. W. 15 to 19 changes to W. by S., slightly ascending, with 20 directly above 19, and about 8 inches above 1. 20 to 30 runs due S. 30 to 60 is a zizzag, 30 to 40 running due E., 40 to 50 S. E., 50 to 60 E. by S. The whole line ascends so that 60 is eighteen inches above 1; but from 20 to 55 the incline is uniform, while from 55 to 60 it is enough more abrupt so that the perpendicular distance from 20 to 55 is just equal to that from 55 to 60, 60 being directly above 59. 60 to 70 runs due S., 70 to 100 S. S. E. 100 is twenty inches above 1. In the whole scheme from 20 onward the multiples of ten are elevated a little above the numbers immediately following and preceding, so that they are more prominent. From 1 to 100 the numbers get more and more distant and indistinct, and consequently appear smaller as they increase in value; but the twenties and fifties seem plainer, but not larger, than the others, as though they were in the direct sunlight, and the others partly shaded. From 100 I drop back to 1 and repeat the course for every succeeding hundred.

The hundreds from 100 to 900 (but not with their units and tens) are arranged in a straight line tending W. by S., scarcely if at all ascending. 1,000 is directly above 999. 1,000 to 1,000,000 is an indistinct line curving upwards towards S. E. by E. From 1,000,000 onward the tendency is upward and in a S. W. direction; but here a haze envelops the numbers so that they are ill defined and hard to follow.

I conceive of the numbers as being of the same size, but appearing to vary in size as their value in reverse order on account of their distance from the starting point. Therefore in giving perpendicular distances I have given them as they would appear on a chart and not as actual distances. The sense of the true perspective is perfect.

In the application of this scheme to every day use it is of inestimable value, since it enables me to add with great facility, and perform any simple mathematical operation with ease and dispatch. I have only to conceive of the numbers before me to be arranged in any required way, as in my scheme in their positions, and they are there without further ado.

As I hinted in the beginning, my mother was the only other person known to me to possess this experience. Hers was a conception of a circle of the numbers from 1 to 100, just the same as my conception of the months of the year. I have repeatedly attempted to make a chart of the scheme as it appears to my mind, but have found it impossible on account of the almost constant change of plane and direction, and the sense of gradually increasing space. I know of nothing that could have given a suggestion of the scheme. The impression came too early to have been suggested by any experience, if there had been one to suggest it.

I add this bit in the hope of further drawing out the discussion of the topic, and I shall look with great interest for further notes. LYNDS JONES.

Oberlin College, Oberlin, Ohio.

ENGLISH ORTHOGRAPHY.

A NEW orthography by J. I. D. Hinds, in *Science* for July 21, is cleverly handled, although some slight inconsistencies have crept in, which, I think, the author has overlooked, in his ardor to reform the present method.

English orthography is far in advance of English pronunciation, and it is a fallacy to make orthography conform phonetically to erroneous pronunciation.

The syllables "tion" and "sion" are pronounced "shun" or "zhun," a mistake or rather a wilful corruption of which no other language deriving its roots from Greek and Latin, is guilty. Now if our "dictionary manufacturers" would prescribe "nati-on" and "provi-si-on" (all vowels but the first short) in their next editions, phonetic orthography would not be compelled to use the abominable "shun" of Josh Billings.

All agree that a new system of orthography (I must be consistent and spell this ortho-graphy, second *o* long) should not be an abrupt departure from the present form. But in the first place let us have *re*-vocable in *pre*-ference (first *e* long) to *rev*-ocable, baro-meters and thermo-meters, as weather-meters, etc., etc.

Mr. Hinds suggests the letter "a" for an intermediate sound of "a" as in last, and also "a" for the short sound of "a" as in mat. I fail to note the difference, unless he pronounces "last" (to use his system) laast.

For the present it would, in my opinion, be pre-ferable to retain the present mode of spelling "mate" and "note," and not "maet" and "noet," not because the latter spelling is less correct, but because the change is too radical. For a like reason th, sh and s should be retained as now in use. It is always necessary to consider the present generation to whom such changes would be burdensome, while the rising generation will naturally adopt any plan we offer them. The dipthong ai as in air is unnecessary as "a" followed by "re" will produce that sound as in "mare," "fare," etc. The letter q may be pronounced kawe, and written without the "u" making "quick" go much "quicker." X is used so much for Latin prefixes that it must be retained for reasons mentioned.

These few suggestions will give printed and written pages a more familiar look, than Mr. Hinds's orthography, and easily read at sight. To show the difference between the plan proposed by Mr. Hinds with the amendments I offer, it is best to use the same stanza :

SOUNDS OF IEVNING.

Swiet waas the sound, hiven oft at ievning's klose
Up yondur hil the villaj murmur rose,
Thare as I past with kareles steps and slo
The mingling notes kame sofend from below
The swane responsiv as the milk made sung,
The sobur hurd that lode to miet thare yung
The noisi gies that gabbeld o'r the pull
The plaeful children just let luse from skuel,
The wac-dog's vois that bade the hwispring weind,
Etc., etc.

However it is idle to write and talk without taking action in this matter. Let Mr. Hinds, if he is a pedagogue, call a convention of teachers through the valuable medium of *Science*. Nothing but stubborn lethargy and indifference hinder the progress of reformation in this branch of study. European nations are continually improving their languages, but the English-speaking savant is so perfect that he alone uses a capital "I," when writing of himself. Such a character will not change his position unless he receives a violent push. FREDERICK KRAFFT.

258 Palisade Avenue, Jersey City Heights, N. J.

AN IMPORTANT OMISSION AT THE WORLD'S FAIR.

To any thoughtful student of affairs, with sufficient foresight to look fifty years into the future, and who realizes a few of the elementary facts regarding the appalling destruction of our forests, a visit to the beautiful Forestry Building at the World's Fair brings a sense of keen disappointment.

There is displayed, in admirable order and with scientific accuracy, nearly every fact regarding the location, size, form, color and commercial value of every kind of tree grown in the country, carefully painted or photographed specimens of leaf and blossom, and sections of trees, showing girth, bark, polished and unpolished surfaces, all carefully classified and labelled, giving evidence to the thousands of tourists who drift by with a casual glance that a great deal of painstaking work has been done, which doubtless, as a permanent museum, would be of great value to the specialist, but which, with the limited time of a tourist, can be of little value to nine hundred and ninety-nine out of every thousand who will see it. The only general impression to be gathered from all this elaborate multiplicity of detail, at the time of our visit, was that the United States produced a great variety of beautiful trees, some of them of enormous size, and that, for aught one could see, it would always continue to produce such trees in the same quantities that it had done in the past.

Nowhere was there to be found the slightest hint of the fact that we are *annually cutting off twice as much timber as we are producing.* Not a word to call the attention of the thoughtless passer-by to the importance of forests to preserve our water-courses from alternate floods and droughts, to the ruthless destruction of beautiful mountain scenery, to the urgent necessity of setting out trees on our dreary, treeless plains and barren city streets.

"There ought to be something done about it, sure enough," said a good-natured, heavy-bearded man from one of the Pacific States, with whom we earnestly discussed the matter. "I never really thought much about it, and of course it isn't in my line, for my business is destroying trees, as I'm here representing a lumber firm like most of the others who have exhibits, but I'll take you to Mr. ———, who is in charge, and you can talk to him." Mr. ——— proved very courteous and somewhat interested in the matter, but didn't know what could be done about it, as his superior had given no directions. "But," we protested, "it could not cost more than ten or twenty dollars to put up a large placard headed: "ATTENTION! FACTS THAT EVERY AMERICAN CITIZEN OUGHT TO KNOW," and underneath in large, clear type, without confusing figures or statistics, give a few of the most cogent fact in such simple form that they could be readily remembered. Not one in fifty knows these elementary facts. If this exposition is to have the educative value that it is hoped, it must be largely by providing important information in simple form, for no one can remember the endless data and statistics which are here provided, and if they could, the one most important fact of all, that we are fast approaching an utter destruction of our forests, is nowhere mentioned."

"The trouble is just here," quoth the lumberman, "everybody has got to look out for himself, and what's everybody's business is nobody's business, you know. And then some of those fellers that took up tree claims out west, well, I've known 'em many a time to plant their trees and get their land, and then let 'em all die, or sometimes even root 'em up," he added with an amused smile, as if he found the whole matter rather a good joke. "You see, most folks don't look at it as you do; twenty-five years ahead is a long time; we shan't feel the pinch much before that, and then—well"—then, we mentally continued, when, like Samson, our strength has been shorn from us, when our hills are as barren as those of Palestine, and our rivers can no longer turn the factory wheels, when our population has doubled, and the price of wood sextupled, then our children, waiting for a hundred years, and toiling with infinite cost and pains to replace what we have destroyed, may well say, "Thus are the sins of the fathers visited upon the children even unto the third and fourth generations." And Mr. ——— smiled courteously, and said he should think it would be a good plan if something could be done about it.

LUCIA TRUE AMES.

Boston, Mass.

THE USES OF THE LITTER BY SPARROWS.

[Editor *Science*: The following incident observed by my step-son, twelve years old, may be of interest in connection with the mooted question regarding the use of tools, utensils and weapons by the lower animals. MERWIN-MARIE SNELL.]

A few days ago, as I was walking along the street near a little park, I saw a sparrow lying upon the ground. It fluttered its wings, but was unable to rise.

As I was looking, a pair of old birds came along carrying between them a little bare twig about three inches long. One had hold of one end of it, and its companion had hold of the other. They brought it down to the bird on the ground, and it caught hold of the stick with its beak.

Then they flew up again into a tree, carrying the third bird hanging to the stick, and by this means brought it to a place of safety.

I am not sure that the bird on the ground was a young one; it looked quite large and may have been wounded or sick. It was not able to fly, anyway, for I saw it try to do so without success. All the birds were common English sparrows. E. STANLEY SPRAGUE.

Chicago, Ill., Aug. 7, 1893.

SPACE RELATION OF NUMBERS.

MR. MARTIN's association of the natural series of numbers with a diagram in space is by no means unusual. As I have a similar association myself I have been interested in the accounts published from time to time by people, most of whom imagine their experiences to be unique. There must by this time be quite a literature of the subject, though I do not know whether any one has kept track of it. I should say, however, that most persons having a strong sense of locality would be apt to associate, not only the series of numbers but also any other series, such as the months of the year or the days of the week, with a space diagram. In my own case the natural numbers begin at my left hand quite close to me and run in a straight line diagonally in perspective into the distance towards the right. Beyond one hundred I can scarcely see them, however. The months of the year are similarly arranged save that the current month is always close to me. Most other series have some sort of space arrangement, the kings of England, for instance, beginning at a distance, and running in a very eccentric curved and zizzag line, finishing near me. I localize almost everything I memorize or think of deeply.

Two localities in particular are associated respectively with the freedom of the will and generalized space, and whenever I think of one of these subjects the corresponding place, with surrounding buildings and scenery, is always vividly present. Of course this is mere association of ideas, but the localization of a numerical series is doubtless nothing more, and I can see no analogy between it and the phenomena of color-hearing, etc., which seem to have for a basis an actual stimulation of two senses by the causes that usually affect only one—probably a purely physiological phenomenon.

It is not necessary to suppose any material basis for the diagram. I used to think that mine arose from my learning my numbers from a set of blocks, which I placed in a row. It seems just as likely, however, that the diagram was wholly imagined, it being easier to remember the numbers when associated with a position in space. It seems likely that many people have these diagrams who do not realize it; I was not always aware of mine till they had been firmly fixed in my mind for many years.

ARTHUR E. BOSTWICK.

Office of The Standard Dictionary, 2 Clinton Hall, Astor Place, N. Y. City.

ROUND WORMS IN THE BRAINS OF BIRDS.

IN reference to the note by Professor G. H. French, in *Science* for June 2, it may be said that many years ago the late Professor Nyman published an article in the Proceedings of the Boston Society of Natural History on a nematoid parasite which lives coiled up in the brain of the anhinga or snake-bird in Florida. The species is *Eustrongylus papillosus* of Diesing. Afterwards, in the Bulletin or Report of Hayden's Geological Survey of the Territories, the volume and year not in my mind at this writing, I described and figured a similar species (*Eustrongylus buteonis*) which was found by a student of mine living under the eyes of *Buteo swainsoni*, while another species (*Eustrongylus chordeilis*, Pack.) was removed from the brain of the night-hawk. These are all referred to in my text book of Zoölogy, p. 169. A. S. PACKARD.

SHARKS IN FRESH WATER.

I HAVE twice noticed extended and circumstantial accounts of the existence, and in great abundance, of genuine sharks in the fresh-water lake of Nicaragua. Though the first account, according to my recollection, appeared in a very reputable publication, I was inclined to think, from the novelty of the idea, that it was merely an invention of some writer who was amusing himself, and filling out an article, but seeing another account by another writer, and even more circumstantial than the first account, I cannot doubt that there is some basis for the statement. If any readers of *Science* know of the occurrence of genuine sharks in fresh water, and especially in the case of the lake above mentioned, I should be glad to have a report to *Science*.

In conversation the other day with one who is a good deal of an authority in such matters, I found that he had no knowledge of any occurrence of sharks in fresh water, but saw nothing unreasonable in the idea. C. H. AMES.

5 Somerset Street, Boston, Mass.

THE many friends of Henry de Varigny, Sc. D., of Paris, France, will be glad to know that he is on the way to this country, having sailed on Aug. 23, being sent by the French government to investigate certain questions connected with the fisheries and applied entomology.

—Corrections: In the letter by Joseph C. Thomson, not Joseph *W.* Thompson, on page 97, for "innovated" read "innervated."

—Charles Scribner's Sons have just ready a little volume of "Stories of the Sea" to match the "Stories of the South," "Stories of New York" and "Stories of the Railway," already published.

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"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | - will exchange for any works or pamphlets on American Slugs or Anatomy of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

I wish to exchange a New Model Hall Typewriter, price $30, for a Daylight Kodak, 4x5 preferred. George A. Coleman, Dep't. Agric., Div. of Ornithology, Washington, D. C.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St., Newark, N. J.

Wants.

I WOULD be grateful to receive replies to any of the following questions.—Is copper found native in Mexico? Is it found native in Cuba? If so, in either or both cases can I purchase authentic specimens? Can any one furnish me with results of analyses of native Mexican or Cuban copper, also analyses of unalloyed copper reduced from the ore from Cuba or Mexico? Is it possible to procure aboriginal implements of copper from Cuba or Mexico? Answers to these questions will greatly aid the preparation of a report for a scientific institution. C. B. Moore, 1321 Locust St., Philadelphia, Pa.

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WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

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QUERY.

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

First inserted June 19, 1891. No response to date.

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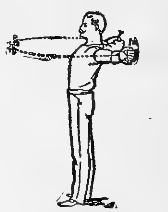

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SCIENCE

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SCIENCE

NEW YORK, SEPTEMBER 1, 1893.

INDIAN RELICS IN SOUTH JERSEY.

BY JOHN GIFFORD, SWATHMORE COLLEGE, PA.

It was the custom of the Indians to visit the seashore at certain times of the year. The trails they followed have been traced across the State of New Jersey. "Beach-day" and "clam-bakes" are customs learned from the Indians. The enormous quantities of shells in heaps along the shore are indications of these migrations and of their fondness for the oyster, clams and other mollusks. A certain kind of clam is still known by its Indian name, *quahog*. Many tons of these shells still remain in spite of the fact that large quantities have been used for roads, for farms and, long ago, for a flux in the manufacture of iron from bog-ore. The size and number of these heaps indicate that the bays and thoroughfares were then literally full of clams and oysters of considerably larger size than those of to-day. There is little else of interest in these heaps besides a few scattered potsherds.

Owing, perhaps, to the lack of fresh water, the inclemency of the weather and the noxious insects which infest these marshes, the seashore was but a transient resting place for the Indian. Tradition says that in spite of their endurance they were unwilling to bear, for any length of time, the bites of those pestiferous flies and mosquitoes.

From the physical geography of the region one may quickly judge where they would locate their permanent settlements. The sands of the interior offered few attractions. Water was their highway and the source of much of their food, so the majority of their villages were situated on prominent points of the rivers, not far from the bays and ocean, not far from fresh water, near fairly good soil, since he cultivated maize and perhaps pumpkins, beans and tobacco, near fresh-water "flats" where the "golden orontium" grows, the rootstalks of which were an important food, where he could find "snappers" or "logger-heads," as well as near a region of berries and game.

In many places in South Jersey the charcoal and grease of his kitchen-middens still blacken the ground. Here, too, are the bones of deer, turtle and other animals, bits of shells, pieces of Indian pipes, charred stones and other relics.

The largest rivers of that region are the Great and Little Egg Harbor or Mullica. On each of these there is the site of what must have been a very large permanent village. Vestiges are found in many other places in the neighborhood, but they are of little consequence in comparison with the region of Catawba on the Great Egg Harbor and of Chestnut Neck on the Mullica River. Two of the tributaries of the latter river are known as the Nescochaque and Mechesactauxin Branches. Another branch, called Edgepeling Creek, was the last resting place of the Indian in South Jersey and before their removal westward. With gratitude and frankness unlooked for in such barbarians, they credited the authorities with honest dealings toward their fathers and themselves.

The word Catawba, although an Indian name, is no way connected with the Indians who once lived there. It was named from the Catawba River, between the Carolinas, which received its name from the Catawbas who once lived along its banks.

Near Catawba, at South River, there are vestiges of an Indian village. Up the main river a short distance there is another at Goose Point. Throughout the whole region, in fact, there are signs of Indian habitations.

Catawba is a deserted sandbluff. Opposite are the fastnesses of a swamp forest. The river winds southward through many miles of marsh. So wild and deserted is the region that it requires but a little stretch of the imagination to see squaws picking berries along the banks or digging the rootstalks of the "Indian club;" others bringing clay from the beds near by, kneading and mixing it with bits of pounded quartz and sherds; others weaving moulds of grass and twigs; others ornamenting the finer grades with dots and lines; others working implements of jasper, and, perhaps, wampum, from shells. A group of wattled huts, thatched, perhaps, with the leaves of corn and calamus, surrounding a fire, on which there is a very large pot in which the rootstalks of the golden orontium are boiling, belongs to the picture.

Orontium aquaticum, so often spoken of by old writers as an important food plant, covers the flats of these rivers. It is believed by some to have been introduced by the Indians. It might be profitable to cultivate this plant, since it is not bad food, although it needs to be cooked full half a day to be palatable.

In the light and durable wood of the white cedar they found excellent and abundant material for their canoes. At Chestnut Neck, so called because of the chestnuts which once grew there, a canoe of chestnut wood was dug out of the marsh.

Chestnut Neck is much nearer the sea and is not so desolate as Catawba. The soil is richer, and the inhabitants well-to-do bay-men. Few Indian bones have been found in South Jersey in spite of careful searching. It may be that they carried the bones of their ancestors away, as did the Nanticokes.

Of all that they left behind them sherds are the most abundant, and fortunately, most valuable. Pottery is an unmistakable evidence of man. Natural formations simulate his handiwork, but pottery, no matter how coarse, is a sure sign of human habitation. It marks best the progress of culture, since that was one of the first, the most lasting and the easiest method of expressing his artistic fancies. The mud-pie was the germ of art. The cultus of a people is often too quickly judged by the coarse sherds which cover almost every campsite. They made common vessels for common purposes. With the distinction of vessels began the separation of artist and artisan. We must measure ability, therefore, by the finest specimens found. Thousands of these bits must be collected, and from these the finest must be selected.

No whole pots have been found, to my knowledge, in South Jersey, but from the curvature of the bits some of them were of very large size. Some of these sherds are not decorated at all, others show signs of more artistic ability than is usually accredited to the Indian. The majority are soft, coarse and mixed with bits of quartz and sherds. Some are hard and fine. Some contain holes near the rim for a bail, indicating that they carried their vessels in their hands and not on their heads. They vary in color, owing to the nature of the clay. Some have peculiarly ruffled surfaces, due to the kinds of moulds in which they were formed. The majority were moulded in baskets of grass.

Some are ornamented with straight lines and dots, others with curved lines, and dots in curves. The simplest decoration is where the edge is dented, as does a baker his pies. Lines often cross each other to form square and diamond figures. The top is often fringed with highly decorative bands. Many of the markings similate the tracks of animals, and on a potsherd found by me at Goose Point there is a picture of a human hand beside another hand, as though in the act of gesturing. Some of these are covered with what a potter would no doubt call a "slip;" that is, a very fine clay mixed to the consistency of cream and smeared over the surface of the vessel.

The pots varied much in size but little in shape. They were mostly almost round, although the writer has found a few angular sherds. Clay pipes are often picked up in their kitchen-middens. These are rude and unornamented. This is worthy of special mention since this peaceful, diplomatic and friendly emblem was usually much ornamented.

Almost as common as sherds are the little slivers and pieces of flint. The jasper which they used was supposed to have been quarried by the Indians in Pennsylvania and was broken by pouring water on the heated stone, as obsidian is quarried to-day. It is interesting to note that the Indian of South Jersey found his jasper elsewhere in another form. This is indicated by the fact that the writer has found many pebbles of this stone partly chipped. On one of these there was the imprint of a fossil shell, which may be a clue to its origin. Arrow-heads, spear-points and awls of jasper have been also found. The slivers of this stone which are so common in spots were probably not chipped but pressed off by some sort of a revolving apparatus. This is indicated by the little round pits which may often be seen in unfinished flints.

Indian axes are very scarce. They were made of a stone which is not found in South Jersey, and owing to their weight sink quickly and are lost in the sand. Potsherds, fortunately, come to the surface.

Such are the faint vestiges of a people who by disease, gunpowder and deceit have been practically exterminated. Some day archæologists will study the pieces of crockery, glass and brickbats, wonder over the old tin cans and brass heads of gun-shells which we leave behind us, and perhaps pronounce our cultus high in the arts and sciences; but in selfishness, the commonest human quality, we are, perhaps, but little, if at all, the Indian's superior.

NOTES ON SOME MINNESOTA MOUNDS.

BY ALBERT SCHNEIDER, UNIVERSITY OF ILLINOIS, CHAMPAIGN, ILL.

In the summer of 1892, while engaged on the zoölogical survey field work of Minnesota, I happened across a considerable number of "Indian Mounds." They were especially common in the Mille Lacs Lake region. All those observed were situated within a few rods of the old shores of Mille Lacs Lake, or of some of the numerous smaller lakes near it. They were all of about the same size and appearance, 40 to 50 feet in diameter at the base and 4½ or 5 feet high. As to the age of these mounds nothing definite can be stated; they are evidently of comparatively recent origin. Some had trees growing on them 2½ feet in diameter. It is reasonable to suppose that they are from 250 to 500 years old.

At Lake Warren, a small lake near the outlet of Mille Lacs, I dug into one of these mounds. Acting under the impression that they were burial mounds, I located a central point and dug perpendicularly downward. At a depth of about 5 feet I reached the level of the surrounding soil. Nothing was noticed but some ashes and fragments of charcoal, indicating that a fire had been kindled on the grave before the mound was built. Continuing the excavations I found the opening of the grave, which was about 4½ feet long by 3 feet wide, and gradually tapering downward to a rounded bottom at a depth of 4 feet. The hole was evidently dug with some crude instrument, as the roughness of the sides would indicate. In this one grave were found the bones of four human bodies and the scales of some fish. The bodies were arranged side by side in a sitting posture, with the legs and arms strongly flexed upon the body and the back toward the side of the grave. From the examination of the bones I made out the following points: One was a child of about six years, another that of a young person of sixteen or seventeen years, the third that of a middle-aged, medium-sized woman, the fourth that of a short, heavy-set, muscular man about fifty years of age. This man's teeth were very much worn, though none were decayed. In fact, all the teeth found were in good condition. Some of the vertebræ, the leg, arm and hip bones were well preserved. Only a few bones of the child were found and it was difficult to determine its position in the grave. It was apparently placed in a sitting position in the woman's lap. No utensils or implements of any kind were found. The sandy soil which made up the mound and filling of the grave was taken from a spot some ten rods distant, leaving a shallow depression.

Numerous pieces of pottery have been found in this region, mostly plain, some with crude ornamental markings near the rim. All pots or vases were rounded. Stone implements were also found. Copper implements were reported to have been found, though I was unable to see them.

The most interesting feature of the grave described is that it contained four bodies, apparently an entire family. How came they to be in one grave and evidently placed there at the same time? The probable supposition is that some epidemic carried away large numbers. In that case would it be likely that the survivors would build mounds over all graves? Or were only those of distinction honored with burial mounds? It is necessary that more mounds be studied before these questions can be answered. No scientific examinations have as yet been made of the Minnesota mounds.

It is probable that there is a close connection as to the time of formation of the "Indian Mounds" of Illinois and Minnesota and the noted "Animal Mounds" of Wisconsin and other states.

In closing, I wish to call attention to the necessity of thoroughly and systematically studying these mounds within the next few years, else the farmer and amateur archæologist will make useless and destroy all.

A UNIVERSITY course of thirty lectures on "Celestial Mechanics" by G. W. Hill, member of the National Academy of Sciences, Honorary Doctor of Sciences of the University of Cambridge, England, will be given in the astronomical lecture room, Hamilton Hall, Room No. 28, Columbia College, on Saturdays at 10.30 A. M. The course will begin on Oct. 14, and continue every Saturday until finished, omitting Saturdays, Dec. 23 and 30. The lectures are open to the public without fee. The course will be confined to the motions of the heavenly bodies considered as material points. Dr. Hill will give a somewhat full presentation of the subject rather than a rapid *resume.* Short numerical illustrations will enable the hearer to comprehend the bearing of the principles enunciated on practical work.

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CURRENT NOTES ON CHEMISTRY.—II.

[*Edited by Charles Platt, Ph. D., F. C. S.*]

FLASH POINT OF MINERAL OILS.

WHILE not strictly chemical in its nature there are but few scientific tests so intimately connected with our safety as the determination of the flash and burning points of mineral oils. This has long been a matter of concern to oil merchants alone, but the scientific public is now taking an interest in the matter, which it is hoped will decrease, if not do away with altogether, the vast number of preventable lamp explosions and fatalities.

The safety of an oil is determined by its flash point, that temperature at which an explosion occurs when a flame is applied to the mixture of air and vapor immediately above the surface of the oil. A flash occurs, but the oil does not take fire and burn continuously, in the ordinary test cup, until a higher temperature is reached, its *burning* or *firing* point. Originally the test was applied to the oil in an open cup, but, this method introducing many chances of error, a closed cup was finally adopted, the flame being inserted through a hole in the cover. 100° F., formerly considered as the minimum safety point for oil, in the open cup corresponds to 73° F. in the closed test, and with the adoption of the latter, the British Government, advised by Sir Frederick Abel, lowered the minimum safety point required by law to this temperature! The reports and papers by Sir Frederick Abel and by Mr. Redwood, who was associated with him, contain many outrageous assertions, among others that an oil flashing at a low temperature is more safe than one flashing at a high temperature. They argued that by using the low-test oils a greater volume of vapor is given off and the air is thus driven from the lamp. A metal lamp was also recommended as the safest on this same principle, that by the heating of the oil in the lamp reservoir vapors are evolved from the oil, and the air being driven out as before, an inflammable, but not an explosive, mixture is obtained. When we consider that 73° F., adopted by the British Government, is a temperature frequently exceeded in our houses, the danger of such a ruling is apparent. Mr. D. R. Steuart presented an admirable paper to the Glasgow and Scottish Section of the Society of Chemical Industry, early last winter, in which the fallacies of Abel's position were forcibly shown. His paper was thoroughly discussed by the members at that meeting and subsequently, with the final result of an appointment of a committee of experts to pass upon the question. Their report fully sustained Mr. Steuart and recommended a higher flash point of minimum safety than that now established by law. Mr. Steuart's paper, presented at that time, and others of more recent date, contain many interesting facts relative to the burning of oils, as, for instance, the relation between flash point and heat developed in burning, the effect of the presence of heavy oils, of chemicals, etc., and of the size of the container.

A lamp burning badly develops more heat than usual, the light is red and the combustion imperfect, producing a disagreeable odor. This may arise from the air not being properly reverberated against the flame; or from the shape of the chimney allowing of back currents; or from the lamp being dirty, the air holes clogged, the wick damp or dirty; the presence of a trace of vegetable or animal oil in the vessels used for filling; or from the oil itself, the presence of heavy oils or refining chemicals. When the oils are not homogeneous, a light and heavy oil being mixed, the heat developed is greater than with either oil separately, this result being more pronounced when a poor wick is used. A well fractionated oil is practically independent of the wick. The treatment of the oil after the last distillation with acid and alkali, results in injury to it, no matter how thorough the final washing. Sulpho compounds of soda are often retained, and these decompose in the burner, forming sulphuric acid, which chars the wick. Carefully fractionated oils are low or high, in flash, in proportion to the specific gravity and boiling point. A low-flashing oil gives the highest temperature in burning. (Contrary to Abel and Redwood).

Another feature has been brought to our attention lately, that of the influence of the size of the containing vessel upon the danger point in oils. The Abel test, it will be remembered, is prescribed as a two-inch cup. A particular sample flashed in Abel test at 78° F.; in the old government open test at 105° F., and *fired* in the old government open test at 122° F. Although a small cup of this oil cannot supply vapor sufficient for a constant flame below 122° F., a larger surface can. The oil above mentioned, tested in an apparatus like the old government open, with a screen around and partly on top, but nine inches in diameter, applying the flame every two degrees, ignited explosively at 88° F. and continued to burn furiously. Applying the flame every degree the same result was attained at 87° F. Transforming the apparatus into a closed test, the oil ignited and burned at 76° F. Except, then, for small surfaces, the flash and burning points are the same, and the Abel flash, becomes a point of danger for oil in store, barrel or tin, while for oil in large vessels, tanks, etc., the danger point is still lower. A case is cited where a large tank of very high flashing oil was being pumped into, the temperature being far below the flash point in Abel cup, vapors were evolved, overflowing through an imperfectly closed manhole at the top, and were ignited at a lamp some distance below. The fire ran back; an explosion resulted, blowing off the top of the tank, and the oil was burned. It is curious to note that while the British Government fixes the flash test at 73° F. for the public, it places the same at 105° F. for its own governmental departments, and at 145° F. for the lighthouses.

EXTRACTION OF FAT FROM FEEDING CAKES.

The extraction of fat from fodder by means of anhydrous ether, after a preliminary drying, or even with low-boiling petroleum, is known to be unsatisfactory. To avoid the simultaneous extraction of coloring matters, resins, waxy impurities, etc., Dr. L. Gebek has conducted experiments, using burnt gypsum mixed with the substance to be extracted, also filtering the ethereal solution through a gypsum filter. Finely powdered gypsum becoming impervious during use, a granular material was obtained by powdering plaster figures, igniting and passing through a 2 mm. sieve. The substance was air-dried and ordinary ether used. Anhydrous ether apparently did not affect the results, though these were lowered by a previous drying of the food stuff. The extracts, though pure, were not constant in weight. Spanish earth was found to yield satisfactory results after the following procedure. The fine powder was mixed with water, sufficient sulphuric acid added to remove the carbonates, and the whole evaporated to dryness and ignited. The mineral was then powdered and passed through a 2 mm. sieve. A cotton plug is inserted in the end of the extraction tube, and upon this a layer of 3-4 cm. of Spanish earth, after which a mixture of the earth and fodder and then another plug. 12-15 grammes of the earth were used for 5 grammes of the fodder. With ordinary fodders the results were the same whether hydrous or anhydrous ether was employed, but with foods rich in fat lower results by a few tenths were obtained with the anhydrous. A previous drying of the substance, when Spanish earth is used, gives low results, probably due to the retention of that portion of the fat which may have been changed by the action of the heat.

Synthesis of Purpureo-and Luteo-Chromium Chlorides.

Professor Christensen, of Copenhagen, has produced by direct synthesis the so-called purpureo-and luteo-chromium chlorides, $Cr\ Cl_3\ 5\ NH_3$ and $Cr\ Cl_3\ 6\ NH_3$. A small quantity of violet chromium chloride, dried at 100°, * is placed in a beaker and immersed in a freezing mixture of solid carbon dioxide and ether. Liquid ammonia (NH_3) is slowly added. At this temperature no reaction takes place, but upon removing from the freezing mixture and warming to —38.5°, the boiling point of ammonia, a sudden reaction sets in, converting the chloride into a red mass, consisting largely of the purpureo-chloride. The excess of NH_3 is eliminated as gas. The product is washed with cold water and hydrochloric acid, finally dissolved in water and the solution dropped into concentrated hydrochloric, in which the purpureo-chloride is insoluble, when the red crystals of the pure salt are thrown down. The first aqueous washings are yellow and yield a yellow crystalline precipitate of luteo-nitrate upon the addition of concentrated nitric acid. The reaction takes place between very narrow limits—immediately above and below the boiling point of ammonia —38.5°.

Determination of Germanium.

Quantitative estimations of the rare metals being unknown to text-books on chemistry, the methods adopted by experienced analysts have a decided instructive value. The following is the procedure in an analysis of the new mineral canfieldite as given by Mr. S. L. Penfield in the *Am. Jour. of Science.* A preliminary qualitative examination was made showing the mineral to be essentially a sulpho salt of germanium and silver. The silver and sulphur were determined as usual. For the germanium, 2 grammes are oxidized with nitric acid, a little sulphuric being added and the excess of nitric removed by evaporation to dryness. The residue is dissolved in water, which has been rendered slightly acid, if necessary, and the silver precipitated with ammonium thiocyanate, filtered and the filtrate containing the germanium collected. The solution is evaporated to dryness in a platinum dish without danger, no acid being present to form with the germanium a volatile compound. The excess of sulphuric acid is driven off by heat, and the ammonium thiocyanate is destroyed by the nitric acid present. The residue is covered with a little strong ammonia (NH_4OH) into which sulphuretted hydrogen is conducted, thus dissolving the germanium oxide and leaving all heavy metals, except those which form sulpho salts soluble in ammonium sulphide, undissolved. The filtrate from this solution is collected in a platinum crucible and evaporated on a water bath, the residue oxidized by concentrated nitric, and the excess of the latter removed by a second evaporation. The mass in the crucible is now gently ignited and weighed, the germanium being determined as the oxide, GeO_2. There is no loss of weight on subsequent heating to a red heat.

Another scheme by which all of the determinations are made in one sample is briefly as follows: Solution in nitric; precipitation of the silver by means of hydrochloric; precipitation of the sulphur with barium nitrate; removal of the excess of chlorine and barium, in one operation, with silver nitrate and sulphuric acid; removal of the silver by means of ammonium thiocyanate; and the final determination of the germanium as above.

*Throughout these articles temperatures will be given in Centigrade unless otherwise stated.

THE WORLD'S CONGRESS AUXILIARY OF THE COLUMBIAN EXPOSITION.

BY GEO. H. JOHNSON, SC. D., ST. LOUIS, MO.

One of the greatest attractions of the Columbian Exposition is outside of the exposition. In the World's Congresses we have an exhibit of the world's intellectual progress and present condition such as has never been attempted before. For the first systematic attempt to make such a comprehensive exhibit of the world's thought by spoken language only the congresses have been very successful. During the whole of the six months that the fair is open the Memorial Art Palace, foot of Adams Street, Chicago, is the place of assembly for those who are prominent in any branch of theoretical and practical learning. At the fair we see the magnificent work of great masters. At the Art Palace we see the great masters themselves. As the creator is greater than his work, as thought is greater than action, so are the world's congresses greater than the fair.

It has been said that President Bonney, since the first day of May, has done nothing but open congresses; and indeed, that is quite sufficient to keep him busy, since several congresses meet each week, and each one is opened by Mr. Bonney with felicitous remarks appropriate to the subject.

Little effort, apparently, has been made here to show the intimate relations which exist between different departments of science and art. To attend one congress and then another exhibits as complete a change as to pass from Machinery Hall to the Fine Arts Building. Since the congresses are designedly meetings for specialists, it is to be expected that very few can take a prominent part in more than one congress. But the wisdom of such a complete separation between dependent and cognate subjects as some of the programs show, is open to question. For example, the Congress on Higher Education did not consider University Extension because the latter subject was considered exclusively in its own congress. The engineering educators could not attend any of the meetings of the civil, mechanical, naval, mining, metallurgical, or military engineers without leaving their own meeting, since all these and others were in session simultaneously.

Perhaps the greatest need of coöperation between closely related specialists was shown in the congresses on experimental and rational psychology. These meetings were held simultaneously in opposite halls of the institute, and each succeeded remarkably well in ignoring the work of their opposite brethren. Indeed, it might have been inferred from some of the remarks that what is experimental is not rational, and what is rational will not bear the test of experiment. A professor in one famous university, in summing up his criticism on experimental psychology, said that the new results of that science, for example, Weber's law, were not strictly true; and their true and valuable results had been set forth centuries before in rational psychology. In the other congress, shortly after, I heard the representative of another great university say that a single study in experimental psychology, carefully worked out, was of more value than all the works on rational psychology which had ever been written. A friendly rivalry between the advocates of different methods is probably stimulating and favorable to the development of science; but the depreciating of all methods except one's own, and the rejection or neglect of results obtained by other methods, is certainly detrimental to the specialist himself, and it lessens the reliability of his work. A conference between all those interested in psychology would have been very desirable.

There were some surprises at these congresses for which the programs could not prepare us. At the Congress on Rational Psychology, over which the venerable ex-President McCosh presided, some *irrational* speakers persisted in making themselves prominent when the subjects were open for discussion. On the other hand, at the Conference on Aerial Navigation, where some people went expecting to see the "cranks," there was nothing but plain statements of observations made, experiments tried, results achieved and theorems proved. At no other congress, perhaps, was there such a pressure of really valuable and original matter. The three days set apart for the conference, with doubt as to whether so much time would be needed for the discussion of such an embryonic art, proved to be quite insufficient; and even a fourth day did not give time for the reading of several valuable memoirs offered by practical and scientific men who are devoting much of their time to arts aerial without hope of any immediate financial return.

The Congress on Woman Suffrage was notable for the large number of men present who seemed to enthusiastically support the claims of their sisters. The Congress on Jurisprudence and Law Reform, where the most serious debates might have been expected, was characterized by the amusing stories and reminiscences of venerable judges.

The Congress on Social Settlements was a very earnest conference between ardent young college graduates, who constitute most of these settlements, and philanthropists and socialists.

The number of eminent visitors from abroad who have participated in most of these congresses has been sufficient to make the term "International" no misnomer. So many valuable papers have been read at these meetings, and the average excellence has been so high, that it is very desirable that the proceedings of all the congresses, including the discussion of papers, should be published in uniform style, fully indexed, and offered for sale at a price to secure a large circulation. An effort is to be made to have such an edition published and widely distributed by our government. The whole work would be a kind of thesaurus of practical knowledge. The theorists and visionaries have contributed their part to each subject, but generally it has been only a subordinate part; and the proceedings as a whole have been characterized by great practical wisdom.

The World's Congresses have been a kind of university for which the fair has served as museums, laboratories and recreation grounds. The congresses, although they have the mottoes, "Not things, but men," "Not matter, but mind," are officially designated as "auxiliary" to the exposition; I am inclined, however, to consider the exposition as auxiliary to the congresses.

A NEW FACTOR IN FRUIT GROWING.

BY B. T. GALLOWAY, WASHINGTON, D. C.

During the past three years the Division of Vegetable Pathology in the U. S. Department of Agriculture has been engaged in the study of twig or fire blight of the pear and apple. In the course of these investigations, which were for the most part carried on by Mr. M. B. Waite, an assistant in the Division, an attempt was made to obtain some definite information in regard to the relation of insects to the disease in question. As a result of this work it was shown that the organism causing blight was disseminated by insects during their visits to the blossoms. The blossoms, it was found, were readily infected by the pear blight germs brought to them by insects, the result being the death of the flower and frequently the twig or branch supporting the latter. This discovery raised the question of the necessity of insect visits to the flowers of pears and other fruits affected by blight. It was thought that if by some practical means insects could be excluded from the flowers without interfering with the fruitfulness of the trees, one form of blight at least might be prevented.

In order to obtain some information in regard to the effect on fruitfulness of excluding insects a series of experiments were made at Brockport, New York, in the spring of 1891. The results of these trials were somewhat startling, as it seemed to indicate a fact hitherto overlooked by scientific and practical men, viz., that many of our well-known varieties of pears will not set fruit unless their flowers receive pollen from other varieties. In other woods, the visits of insects, by means of which cross-fertilization is effected, is necessary to insure proper setting of the fruit.

To obtain further information on this subject more extended experiments were made on this subject in 1892 and 1893. This work was carried on in Virginia, New York, and New Jersey, the results in every case confirming those obtained in 1891. The facts obtained by these investigations seemed sufficient to warrant the important conclusion that most of our common varieties of pears and apples are unable to fertilize themselves. This law can hardly be called new, for Knight, Darwin and others have touched the same point in a broader and more general way. Strange to say, however, no one, up to the present time, seems to have applied the conceptions of Darwin and others on this subject to some of our common fruits, although it has long been recognized that orchards of pears, apples, plums, etc., fail to bear fruit regularly, even under the most favorable conditions.

In the light of our present knowledge it is known that unfruitfulness, in many cases, is due to the fact that large blocks of single varieties have been planted. In such cases there is not sufficient foreign pollen to effect fertilization, consequently the trees bloom profusely but no fruit sets. The new factor, therefore, which confronts the grower of pears and apples is to select his varieties and plant them in such a way as to insure cross-fertilization. Of course, in doing this it will be necessary to observe a number of important poiuts, the details of which need not be given here. Suffice it to say that the time of flowering of the various varieties must be kept in mind in selecting those designed for pollinating. Then again, the question of the potency of the pollen with respect to the variety it is intended to grow must of necessity be considered, and, finally, it will be important to know what proportion of pollinating trees to trees it is desired to fruit should be planted.

RAILROAD SIGNALING.

BY REGINALD GORDON, COLUMBIA COLLEGE, NEW YORK.

The chief object of signaling on railroads is to inform enginemen positively, at given points, whether they must stop or proceed, and the universal method of conveying this information is by a visible signal. Audible signals have been tried, but their use is rather limited. At the high speeds now usual on our railroads, an engineer ought to be able to interpret the meaning of a signal at some distance before he reaches it, so that if obliged to stop, he can bring his train under control and stop it, before reaching the point where actual danger exists, whether it be a train, an open switch, or some obstruction. The necessity of an easily distinguishable signal is thus obvious. In the early days of railroading, when trains were comparatively few and speeds were low, it was sufficient to have flagmen or watchmen, waving a flag by day, and a lantern at night. These men were of course governed by orders of the local superintendent or roadmaster. If a train stopped unexpectedly, or longer than usual, a brakeman was sent back with a flag or lantern to protect his train against a following one. Two great improvements were made in railroad operation when fixed signals, on poles or posts alongside the track, were adopted, and when the method of keeping trains apart, and protecting them, one against another, known as the "block signal" system was introduced. These fixed signals were moved by a combination of rods, wires and levers, worked by an operator situated at some distance and controlling, at the same time, several other signals in a similar manner.

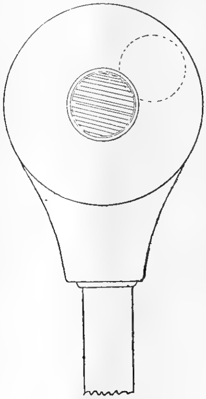

FIG. 1.

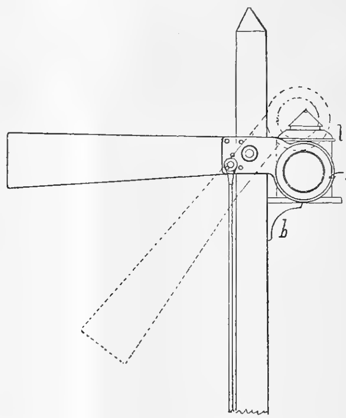

FIG. 2.

Of all the different forms for signals that have been tried, the disc and the semaphore are the only ones in use now. The disc signal may give its indications for safety, either by turning through 90°, so as to show only its edge, or by moving bodily out of that part of the signal case which, when occupied, means "danger." Fig. 1 shows an electrically operated disc signal at "danger;" and the dotted lines show the "safety" position. The semaphore signal, fig. 2, is more positive in its indication, because it is more easily discernible than a disc. The safety position of the semaphore is shown by the dotted lines in fig. 2. The blade or arm carries a frame, *F*, in which a red glass is fixed, so that at night, when the blade is raised to indicate danger, the lamp, *l*, fastened on the bracket, *b*, will show a red light. When lowered for safety, the lamp is uncovered, and, of course, shows white. The introduction and recent rapid extension of block-signal systems of various kinds has led to the almost universal employment of semaphores, and even where an absolute block system is not maintained, train movements, either on the open road, or within yard limits, are controlled mainly by this form of signal. The necessity of keeping two trains apart by a space interval, rather than by a time-interval, has been demonstrated in a most forcible manner by the long list of rear-collisions on railroads relying solely on the rear brakemen to keep trains apart. In the former method the road is divided up into spaces or blocks, and no train is allowed to enter any block unless the last preceding train shall have passed beyond its limits. The limits of each space or block are marked by signals, usually semaphores, operated directly by a signalman, or else controlled by him through the intervention of compressed air and electricity. The safety of trains, then, rests mainly upon the faithfulness of the signalmen, as well as the vigilance of the locomotive engineers.

Under the time-interval system, trains are not allowed to follow one another closer than after an interval of five, seven or ten minutes, according to the class of trains and their relative speed. With this system everything depends upon the faithful and active performance of duty by the rear brakeman of a train. Some railroads, unable to incur the expense of installing and maintaining a first-class block-signal system, have provided signals at every regular station, where the station agents, being in telegraphic communication with one another, can, if necessary, carry out a very fair "absolute" block system. Each station, then, marks the end of one section and the beginning of another. In times of heavy traffic, however, these blocks between stations are too long; that is, trains are kept too far apart, and compelled to wait so long at stations that the road could not be kept clear, and the service would become demoralized if this method were strictly adhered to. For these reasons, and under the circumstances cited, it is quite usual to allow trains to follow one another after an interval of time, determined in each case to suit the circumstances, and the practice thereby becomes "permissive," as opposed to "absolute" blocking. This method of operating is in use at present on many roads, and, though it no doubt prevents many collisions, is vastly inferior to an absolute, interlocking system of block signals.

Railroads with very heavy traffic, and traversing thickly settled regions, have lately found it necessary and expedient to equip their lines with this latter system, and it is a question of only a few years before all our great trunk lines, or, in fact, all lines running trains at high speed will be thus protected. The earlier forms of block systems comprised a semaphore for each track, controlled from a cabin or tower at the entrance to each block or section. Telegraphic communication was established between these towers, and the movement of trains thus pretty well controlled, of course always assuming proper vigilance and devotion to duty on the part of the tower men and engineers. Nevertheless, accidents have happened by reason of a signalman forgetting that a train has lately passed his tower, and allowing another to fol-

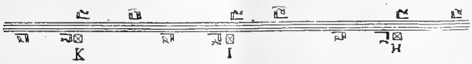

FIG. 3.

low it, without any information from the tower ahead. In the latest systems brought into use, the danger of such carelessness is largely, if not entirely, overcome, by interlocking the signal levers in two successive towers. By a combination of mechanical and electrical devices, each lever that moves a signal is locked in position by the man in the tower at the farther end of the block section, and can be unlocked only with the latter's consent and coöperation. For example, in fig. 3, a signalman at *H* cannot lower his signal to "safety," in order to admit a train to the block ahead, without asking the operator at the next tower, *I*, to unlock his (*H's*) lever. The man at *I* will not do this unless he knows that the block or section *H-I* is clear. A train having passed *I*, going towards *K*, and protected by a danger signal at *I*, the signalman there, on request of *H*, will unlock the latter's signal

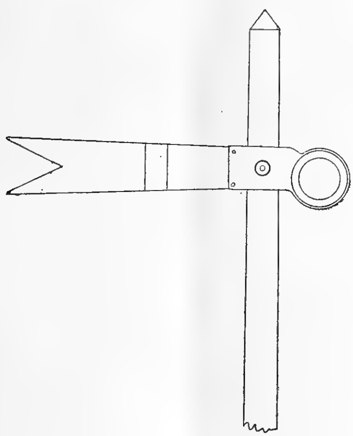

FIG. 4.

lever, so that he can lower his semaphore to safety, and admit a train to block *H-I*. It is usual, also, to have each signal in duplicate; that is, a semaphore placed from 1,200 to 1,600 feet in advance of the one at which an engineer must stop, if it stand at danger. The latter is called the "home" signal; the former, the "distant" signal. Home signals are almost invariably painted red, and of the form shown in fig. 1. At night they display a red light when the blade is raised to danger position. Distant signals are made of the "fish-tail" form, as shown in fig. 4, and painted green or, rarely, yellow, displaying a green light at night when raised to indicate "caution." A distant signal is for the purpose of informing an engineer whether he will find the home signal at danger or not. In moving the blades to indicate danger, the distant is first raised, then the home signal. In lowering them, however, the reverse order is used. If an engineer finds the distant signal lowered for him, he can go on confidently without slackening speed, knowing that he has a clear block ahead. If, however, it is against him, he then has time to bring the train under control and come to a dead stop on reaching the home signal, which, if at danger still, he must under no circumstances pass. In the Fourth Avenue tunnel, New York City, the signals are arranged so that the act of moving a signal to danger, places a torpedo on the rail over which the train must pass, and in addition to this, a gong is set loudly ringing if an engineer, neglecting the ordinary signal, runs beyond a certain point. Setting the signal to safety again removes the torpedo and throws off the gong mechanism. These extra safeguards have been found to be absolutely necessary in this place, where the traffic is so dense and the conditions of working are so trying.

ALTITUDE IN SPITE OF HUMIDITY AS A CURE OF BERI-BERI.*

BY ALBERT S. ASHMEAD, M. D., NEW YORK.

THE Hakoné Mountain resorts, 836 metres above sea-level, Karuizawa, the new foreign resort, the religious stations (ten) disposed on each of the four roads up the sacred Fuji Mountain, and the Ikao Mountain and hot springs resort at Nikko, are the main beri-beri resorts of Japan. All these are in the neighborhood of volcanic centres. Karuizawa, at the head of the Usui Pass, is 3,000 feet above sea-level. Its mean temperature is 8° lower than that of Tokio, in the principal Kakké month, August; and there is a mean oscillation of 20° F. in the temperature of the day, as compared with the night. While at Tokio the variation is only 14°. It is this coolness of the nights, in all the mountain resorts of Japan, which makes the heat of the day tolerable. The August humidity, in all the mountains of Japan, although they have three times the rainfall of Tokio, is practically the same as in the latter city.

Yamanaka, another resort in the Hakoné Mountains, is higher even than Karuizawa, the same conditions as above.

Fuji, the peerless mountain of Japan, is 12,238 feet high. Its slopes are cultivated to an elevation of 2,000 feet. It can only be visited in the Kakké season, July and August. At other seasons, it is too cold. The highest temperature that has ever been recorded in August, on the summit of Fuji, was 70.5°, and the lowest 31.1°. The mean daily range of temperature is a little higher, 20.9°, than at Karuizawa; that is the variation between day and night. There are at the top of the mountain thirty-six inches of rainfall, and three-fourths of the whole quantity belong to the three or four days of the first storm of the month. The influence of Fuji in encouraging precipitation, is shown also at Karuizawa, the latest beri-beri resort, and in the other resorts.[1]

The comparison between the three, top of Fuji, Yamanaka on the Hakoné Mountains, and Karuizawa, gives the following figures:

	Bar.	Range.	Temp.	Range.	Vap.	Hum.	Rain-fall.	Rainy days.
Top of Fuji........	490.7	13.1	7.7	11.6	5.5	71.2	888.1	18
Yamanaka (Hakone).	677.5	11.8	20.6	9.6	16.0	88.7	580.4	18
Karuizawa.........	679.13	10.	21.3	11.1	16.0	86.	212.0	17

*Communicated to the Sei-I-Kwai, or Society for the Advancement of Medical Science in Japan.

1 Ashino-yu is at Ubago, near the base of Fuji. Hakone Lake is separated from Fuji by a ridge. Yamanaka Lake is seen from the top of Fuji. The same influence operates at Ikao; this is near Asama-yama, the second highest volcanic peak in Japan (Shinano.)

The meteorological station which is nearest these resorts is called Numadzu; it is at sea-level, about twenty miles west of the Hakoné Mountains, on Sugura Bay, Pacific side of Japan. The notations for August are:

Bar. Range.	Temp. Range.	Vap.	Hum.	Rainfall.	Rainy days
757.6 12.7	25.8 7.2	20.5	83,	187.2	23.

The average humidity at Tokio, sea-level, for the three Kakké months, June, July and August, as given in the meteorological summary, is 81.6. This figure is inferior to that shown by mountain resorts.[2]

It will be seen that recovery from beri-beri takes place in these noted places, in spite of their excess of humidity and rainfall, which makes it evident that the humidity and rainfall of the Kakké months, June, July and August, at sea-level, in the beri-beri centres, cannot be a direct cause of the outbreak.

Another cause must be looked for. The history of the following case shows that a high altitude is absolutely necessary for a real cure of Kakké.

A patient of mine, M. H., 23 years old, a ship builder and a powerful man, by no means anœmic, a native of Kochi (a city of 50,000 inhabitants, not a beri-beri centre, on the sea-level, island of Shikoku), contracted beri-beri in Tokio, June, 1885. He was a patient at that time of Dr. Ikeda, the emperor's physician. He was ordered to the mountain, but his father insisted on his returning home. He recovered and came back to Tokio in October. In June, 1886, the disease reappears; this attack is stronger than the last; for ten days he is unable to walk at all. He has this time the attendance of Dr. Sasaki. That eminent physician tells him that he must stay in the mountains near Tokio, and not return home, if he wants to be cured for good and all; should he go back, thinks the doctor, the cure would only be temporary. The patient disregards this advice, and goes again to Kochi, and recovers in September, as before. He arrives again in Tokio in November, spends there the winter and the following spring. In May, 1887, there comes upon him a third attack, not a strong one this time. As usual, he retreats to his native place, and recovers in August. He betakes himself to Yokohama, and in November sails for San Francisco, where he spends the winter. May, 1888, finds him again in Tokio, and this year he escapes beri-beri. He stays all summer in Tokio, and all winter, and in June, 1889, he has a fourth attack of beri-beri. This time again he flies to Kochi, and recovers only in October. After recovery he reappears in Tokio in November, and spends there the winter and the spring. In May, 1890, he goes back to his native place before the beri-beri season begins, and escapes. He spends the following winter in Kobe. In 1891 he returns to Kochi, and spends the summer. He again is spared. (It must be observed here that in Kochi, his native place, there is but little charcoal used as compared with Tokio, and that the city, situated at the head of a seven-miles bay, is not surrounded by hills or fells, which might coop up the deleterious products of combustion: it was really from this carbonic poisoning that he was escaping during his sojourn at Kochi). The winter he spends in Tokio. In April, 1892, he goes to Osaka, having heard of the improved climatic conditions for beri-beri patients of that place, for the purpose of getting out of the range of the disease, but does not succeed. He is visited by it there and recovers in September, having been only one month sick this time. He spends the winter in Tokio, and in May comes to the United States.

He has neglected the only remedy which can have any real and lasting effect on his case; that is, in his own country, the mountain air. He is not cured, though his diet has been irreproachable, at least for years.

Dr. Toyama, who has charge of the beri-beri hospital at Usigomi, Tokio, has in his hospital, in the beri-beri season, from 100 to 200 patients. This establishment is situated on the highest ground of Tokio. A vegetable diet is imposed upon the patients; they get no milk, no meat, no fat fish. If they decline to remain in the hospital or do not improve, he orders them to the Hakoné Mountains, about eighty miles southwest of Tokio, or to the hot springs Mountain of Ikao at Nikko, eighty miles north of the capital.

An albuminous diet is not considered by this eminent physician as of signal importance for the cure of beri-beri: it is the altitude, even the moderate one of his own establishment, that does it. If one high place has no effect, he sends his patients to a still higher one. Does this suggest, in any human mind, the idea of rice and anœmia as the causes of a disease which disappears, almost at once, when the air is pure, rich in oxygen, comparatively free from carbonic emanations? If the cure takes place (and even in the Kakké season) where the degree of humidity is the same as, or greater than, in the beri-beri centres; and where the vegetable diet is compulsory, neither humidity nor anœmia resulting from a non-albuminous diet can be chief etiological factors of beri-beri, or, to express my opinion with complete frankness, can be factors at all.

One can hardly suppose that any merit in the cure of beri-beri patients can be attributed to the springs themselves around which the stricken herd gather. For why do not the same mild chalybeate and sulphur compounds (see Dr. Geert's analyses) operate in the same manner at sea-level. Hot bathing is also out of the question, it being in Japan a universal, almost passionate, habit. Consider also this fact: There are in Japan some excellent arsenic springs. It is well known that arsenic is the principal remedy for chloro-anœmia. Yet beri-beri patients find no benefit in them. There is, at any rate, no rush there, as would certainly be the case if beri-beri was an anœmia.

I have obtained, recently, some facts about the beri-beri situation in the island of Java, and I think I will append a few to this sketch: The Batavia beri-beri hospitals are situated at Buitenzorg, the old capital of Java. They are built on very high grounds; it takes a two hours ascending drive from the seaport to reach them. The patients are brought thither from the sea-level. The doctors in charge of these patients feed them rice and curry and eggs in different forms. The patients themselves, strange to say, take exception to a meat diet. The chief source of success, the doctors avow, is the climate.

In the whole of Java, the beri-beri outbreaks are at sea-level.

One thing is made evident by these facts: the beri-beri specialists, not only of Japan, but of Java, the cradle of the disease, have been taught by the most persuasive of all masters, long experience, that the cure of beri-beri has little or nothing to do with the diet, as they feed their patients even with vegetables. They seem to know by instinct that the disease must disappear as the red corpuscles are recreated by the ozone of the mountain air. It is not, as I view the matter, the condition of the red corpuscles, in itself, that causes the disease, nor does their rehabilitation in itself constitute the cure. But, as these red corpuscles reacquire the faculty of carrying oxygen, the carbonic toxine is eliminated, and with it the very root and soul of the disease, Dr. Takaki's rice and anœmia theory to the contrary notwithstanding. It is the elimination of the paralyzing element, carried by the blood, which, when thus recreated, the red corpuscles are

[2]For most of these facts, I am indebted to Trans. of the Asiatic Soc. of Japan.

able to bring about; it is this elimination, and nothing else, that constitutes the curative action.

I will now beg the reader to ponder over the two following facts, and see if he can reconcile them with Dr. Takaki's theory: 1st. The mountaineers of Japan, who have the reputation of being rice-gluttons, eating, in fact, nothing else, are never afflicted with beri-beri. 2nd. There is, in the mountains of Japan, one beri-beri centre, and only one. What is more, this exceptional place is 800 metres above sea-level, it is called Shinano.[3] But see how strikingly, here, the exception confirms the rule. Shinano is again surrounded by higher hills, so that it is really a cup from which the carbonic gases cannot escape. The outbreaks of beri-beri in Shinano are explained by the latter circumstance, not by any extra rice-gluttony of the Shinanoans, or the excessive humidity of their climate.

THE ORIGIN OF GOLD.

BY PHILIP LAKE, CAMBRIDGE, ENGLAND.

THE subject of the origin of gold, or of the manner in which that metal has reached its present positions, is one which has at all times excited considerable attention, and the number of theories put forward has been almost as great as the number of writers on the question.

It is easy to understand the presence of gold in alluvial deposits, for this has clearly been derived from preexisting rocks; but the difficulty lies in determining how the auriferous quartz-reefs and other rocks which we look upon as the home of the gold, became impregnated.

Sir Roderick Murchison, from his observations in the Ural Mountains, originally held that non-alluvial gold was only found in Paleozoic rocks, and principally in his Lower Silurian; but he believed that it was not introduced into these rocks until shortly before the Drift period. Subsequently he was led to modify these views to a certain extent, and to admit that Secondary and Tertiary strata when penetrated by igneous rocks or impregnated by mineral veins, might also contain gold.

More recent observations show that gold may be found in rocks of any age in metamorphic strata; but all the evidence seems to support Murchison's next contention, viz., that gold is of igneous origin.

There is probably no more instructive area to illustrate this than Southern India, where the distribution of gold has been carefully worked out by Mr. R. B. Foote, of the Geological Survey of India. Almost the whole of this part of India is made of crystalline and metamorphic rocks; and in it there are a large number of gold fields, more or less rich. A closer examination of the country shows that we have here a large mass of gneissic and granitoid rock which is crossed by a number of bands of schist, lava flows, hæmatite beds and conglomerates. Mr. Foote has shown that these bands belong to a system which is distinct from, and newer than, the gneiss, and to this system he has given the name of Dharwar. He has shown also that all the gold fields of Southern India, with the possible exception of the Wynaad, lie within these Dharwar bands.

As usual, the gold is found principally in quartz-reefs; and it is a remarkable fact that though quartz-reefs are by no means uncommon in the gneiss, as well as in the Dharwar beds, yet those in the gneiss are never auriferous. It is clear therefore that the gold cannot have been introduced into the reefs from below, for in that case there would be no difference in that respect between the reefs in the gneiss and the reefs in the Dharwar.

Only one other possible conclusion remains, viz., that the gold originally lay in the Dharwar rocks themselves, and that it has since, by some process of segregation, been gathered together in the quartz-reefs.

It has already been stated that lava-flows occur among the Dharwar rocks; and my own observations have led me to believe that many of the schists also are lava-flows. In fact a very large part, if not the greater part, of the system appears to be of volcanic origin.

It may be concluded therefore that the gold which we now find in the auriferous reefs of Southern India was derived from the rocks of the Dharwar system; and that it was originally brought up from the depths of the earth by the lava-flows which form so large a part of that system.

ON THE EXTREMES OF HEAT AND COLD UNDER WHICH THE LIFE OF SPECIES IS POSSIBLE.

BY HENRY DE VARIGNY, SC. D., MUSEUM OF NATURAL HISTORY, PARIS, FRANCE.

MARQUIS DE NADAILLAC contributed some months ago (January 27, 1893, page 49) to this paper an interesting note concerning the extremes of heat and cold endured by man, on the extremes of external temperature which man has been able to resist. The topic I wish to call attention to is entirely different. We all know that man, for instance, when resisting the extremes of heat and cold, hardly alters at all his internal temperature, and that when for some reason or other the latter decreases or increases, life is in great peril. To show the extremes of heat and cold man can endure is merely to illustrate the means he has at his disposal to fight heat and cold and to maintain his own internal temperature, and as these means are numerous and powerful, we may well feel assured that man may resist very extreme conditions by intelligent use of the offensive or defensive weapons he is provided with. The matter I wish to call attention to is the very reverse, in one sense, of the facts quoted by Marquis de Nadaillac. I wish to show which are the extremes of heat or cold which individuals may really undergo permanently, without damage to themselves and posterity. To answer the question, we need to consider organisms which have no proper heat to speak of, but assume the temperature of their environment; we want what generally goes by the name of *cold-blooded*, or *heterothermal* organisms, and we must have them aquatic, not terrestrial, because we very well know that terrestrial cold-blooded animals do not necessarily have the same temperature as the air which surrounds them; nor do plants. Air is a bad conductor of heat, and in air evaporation and transpiration prevent the temperature from going very high. So we want organisms living in water, because in this case, as they hardly produce any heat, they must necessarily have the temperature of the water they live in, moreover we want our organisms to be able to withstand heat or cold, not only individually, but specifically: they must resist as individuals and as members of a species, they must be able to proceed to reproduction. In fact, what we want is the permanent extreme degree of water (in heat and cold) under which organisms are able to live, and to give off posterity.

As far as I can judge at present, these extreme degrees are, in Centigrade scale, minus 2° and plus 74°.

Arctic explorations have shown that even within the

[3] "Even the rule that the disease does not overstep certain quite low levels is shaken now; for the province of Shinano, walled in by mighty mountain chains, forms a plateau which, in many Kakke-ridden places, is raised 800 metres above the level of the sea. But, although these regions are not near the sea-level, they have yet a comparative depression; that is, they are low-lying plains, by the side of the circumjacent mountains, a circumstance of vast significance." BAELZ.

"Within the cities, also, the deep-lying parts show more cases of the disease than those of an elevated situation." BAELZ.

coldest of northern regions life is never totally absent, and may be found when carefully searched for. But, it must be conceded, life becomes "living," so to say, only during a very short period, a rapid summer, during which the temperature rises above zero. The study of marine cold-blooded organisms, in the northern climes, furnishes, I think, the extreme limit of cold under which organisms can live and reproduce themselves. Fr. Kjellmann, during his wintering in Mosselbay (Spitzbergen) some twenty years ago, observed a number of algæ at the coldest period of the year, and was satisfied, by direct observation, that they did most decidedly give issue to the sexual elements, and that the process of reproduction was in full activity while the temperature of the water was permanently below zero, between -1° and -3° (salt water having a lower freezing point than fresh, about 3°). I do not know of instances of organisms thriving individually and specifically at lower temperatures, of organisms doing the same, while their internal temperature cannot be above that of the environment. Lichens must certainly be considered as living at much lower temperatures, since they perform the breathing function at -10°, -20° and at much lower aerial temperatures, but do they reproduce themselves under such conditions? Experiments are wanting, and till they have been performed, we may consider that the *lowest internal temparatures* at which organisms may *thrive and reproduce,* is -2° or -3°, and that some algæ do live under these conditions in the northern seas amidst the blocks of ice (Kjellmann: *Vegetation hivernale du Algues a Mosselbay, Spitzberg, apres les observations faites pendant l'expedition polaire suedoise en* 1872-1873: *Comptes Rendus de l'Academie des Sciences,* 1875).

As to extreme heat, I find no instance more satisfactory than that of Van Tieghem. In a paper, *Sur des bacterianes vivant a la temperature de 74° Centigrades* (published in the *Bulletin de la Societe Botanique de France,* 1881, Vol. 28), he has given the results of his experiments on certain bacteria, and has found that one species is able to thrive and to reproduce itself at 74°, while at 77° it dies. Many other micro-organisms can bear for some time 60° or 70° C., but I know of no other able to live permanently at 74° and to give posterity under such conditions. No doubt a large number of observers, of whom I have given some names, with the results they have obtained, in a paper: *Les temperatures extremes compatibles avec la vie,* (*Revue Scientifique,* 27 May, 1893), have given instances of plants and animals living in hot springs, and, if some were to be believed, animals and plants would have been found in boiling water. I do not say the thing is impossible, but great care must be taken when ascertaining the temperature of thermal waters. Hoffe Seyler has shown that under the uppermost layer of water, which may be very warm, colder layers are to be found, and animals may seem to live in heated water, when in fact they live in normal conditions. Unless special care is taken to observe the temperature at the very level where living organisms are found, we can take no serious account of the numerous and startling observations made by a number of travellers, and abstracted by Goeffert, formerly, and recently by H. Weed (*9th Ann. Rep. of U. S. Geol. Survey by Powell,* p. 619). There is no reason to suppose that no organisms can live and reproduce themselves at an internal temperature of more than 74°. Such organisms do doubtless exist, but we cannot feel assured of the fact yet. Persons who investigate thermal springs should be very careful in their measurements; correct observations can be of great use for the present question, although, in point of fact, I much prefer a good experiment, such as that of Van Tieghem's. But nothing prevents the completion of the observation by experiment.

BOOK-REVIEWS.

Abnormal Man: Being Essays on Education and Crime and Related Subjects. By ARTHUR MACDONALD. Washington: Government.

THIS is a goodly pamphlet of more than four hundred pages issued by the Bureau of Education, of which the author is an officer. It is of a somewhat desultory character, consisting mainly, as the author says in his preface, "of essays and of digests of foreign literature which have already appeared in different periodicals." These various articles, however, have been changed, more or less, and much new matter has been added. The object of the book is to inquire into the causes of crime with a view to their removal, and especially to consider the influence of education in repressing crime. It opens with a brief notice of the various classes of abnormal men, whom the author divides into four classes: the dependent class, including the inmates of almshouses, hospitals, orphan asylums, etc.; the delinquent class, or criminals; the defective class, such as the insane, imbecile, deaf and dumb and others; and finally, men of genius or great talent. The ranking of men of genius with the other classes mentioned is itself a rather abnormal proceeding, and the chapter in which the author endeavors to show that genius is nearly allied to insanity is likely to meet with little favor. His remarks on that subject, however, are aside from the main purpose of the book, which is to treat of the criminal class and the methods of eliminating or repressing it.

At the outset Mr. MacDonald raises the question whether and in what way the elementary education that has now become so general throughout the civilized world affects the increase or decrease of crime; and after presenting many tables of statistics on the subject, comes to the conclusion, which the reader is likely to share, that "the exact relation between education and crime is unknown." He remarks, however, that "it would be difficult to find a criminal who in a single instance could attribute the cause of his crime to education;" and adds that "perhaps as good a test as any is for one to ask himself if the teaching of ordinary branches in his school days gave rise to immoral or criminal desires." But if school education does not increase crime, there is not much evidence that it tends to diminish crime; and thus we are brought to the subject of moral education as distinguished from the intellectual sort, which is the chief product of the schools. Mr. MacDonald justly remarks that "while the moral and intellectual sides of education necessarily exist together, yet society is most solicitous about the former; for an individual may be a good citizen with little instruction if he has sound morality, but the reverse is not true." This, however, immediately raises the perplexing question, which is as old as Socrates, and which moralists of all ages have tried to answer, whether virtue can be taught, and, if so, by what means; but though our author realizes the importance of the problem, we cannot see that he contributes anything new to the solution of it.

The relation of education to crime, however, is only one of the topics discussed in this book, which deals with the whole subject of criminology with special attention to the question of preventing crime. In pursuing this theme the author says little directly about remedies, but confines himself mainly to the study of causes, on the ground that "all the conditions, occasions and causes of crime must be investigated first, if the treatment is to be a rational one." After pointing out the special topics for inquiry in criminology, he proceeds to set forth the views that have been advanced by leading writers on the subject in recent years, with special reference to the theories of the Italian school, which inclines to regard crime as a mental disease. Mr. MacDonald's own views are expressed with caution, and in many cases he confines himself to expounding the ideas of the author he is dealing with, without offering any opinion of his own. The question of alcoholism in its relation to crime is treated at considerable length, and the views of many different writers presented; but, as is usually the case in discussions of that subject, the variety of opinions prevailing and the lack of sufficient information about the actual physical effects of alcohol result in leaving the question unsettled.

Mr. MacDonald's book contains much that will be useful both to those who are beginning the study of criminology and to the original investigator. To the former it will suggest the most important topics for investigation and the proper methods of work, while to the latter it will serve as a guide to the literature of the subject in all its departments. In this last-named respect the book is especially strong, since it gives not only a great many digests of recent works, but also an extended bibliography of the whole subject, filling more than two hundred pages. On the whole, though we do not agree with all the author's views, we have found his book on many points both interesting and suggestive.

LETTERS TO THE EDITOR.

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

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

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

Animal Vocabularies.

Certainly one who believes in evolution cannot deny the existence of a language, of some sort, which enables the lower animals to communicate in a more or less intelligent degree.

Even my five-year-old little girl feels assured of the fact that animals can talk, "but not in our words." Only yesterday I sent her to the barn with an armful of fresh corn husks for our pony. She came running back with beaming countenance, exclaiming: "Daisy was so glad, she wanted to kiss me."

Several years ago I took great interest in some fine Brahma chickens we had raised from fluffy little chicks. There was one fine old grandmother hen which we bought to start with. She came recommended as a "good mother." And a good mother she proved to be, but she had her way of training a family. She went at it in earnest. She clucked and scratched and pointed out the best things to eat. She was fully impressed with the fact that she had a duty to perform, and she had the courage to devote herself entirely to this duty. But she always insisted upon early independence. She did not approve of chicks clinging to her and depending upon her when they were able to "scratch" for themselves, and hence she made it a rule to "wean" them early. She always gave them a parting lecture. She looked very wise and solemn, and "ca-cawed" in a peculiar tone, while the chicks stood about her in a sort of dazed, sorrowful way, wondering, no doubt, what would become of them. One "talk" ended the matter. She went off to roost alone, and the deserted chicks huddled together, "vaguely thinking" what a cold world.

Another interesting characteristic about this old grandmother hen was her solicitude for young hens who were just beginning to experience the first inclinations to sit. She would stand before their nests, and "talk" in the most earnest, subdued tones; her vocabulary must have been quite extensive, for she could continue without any hesitation for such a long time. It always seemed to me that she was relating her own experience and giving advice to the young and inexperienced of her kind. Certainly the young hens appeared to listen with all the respect possible—they no doubt "thought" that she magnified the cares and responsibilities; at least she never dissuaded a young hen from her resolution to *sit*. I agree with the writer in the last issue of *Science* (No. 549), who says "there is no need of going beyond the barn yard to hear a definite animal vocabulary of a considerable number of words."

If our language is the result of evolution, it has come up through lower forms, and it is only legitimate to credit animals with a varying degree of power of communicability. Mrs. W. A. Kellerman.

The Circulation in Fresh-Water Mussels.

In order to demonstrate the course of the circulation in a fresh-water mussel the student is commonly directed to make six injections: from the ventricle forward into the systemic arteries; backward through the auricles into the efferent branchial vessels; from the vena cava forward into the organ of Bojanus, and backward into the system; and into one of the branchial sinuses forward into the gills and backward into the organ of Bojanus.

I have, however, sometimes succeeded in demonstrating several of these connections by a single injection as follows: Cut away a small portion only of the outer lamina of the outer gill, make a little opening into the branchial sinus and with a very slow, steady pressure inject into it. The course of the injection may then be easily watched as it proceeds down the inner lamina of the gill, and after a little time begins to ascend in the outer lamina. Presently it will begin to escape at the cut ends of the efferent branchial vessels; enough of these are, however, left intact, so that most of the fluid passes on up to the auricle, thence into the ventricle, and it may be followed as it sets out from the heart towards the front and rear of the body on its systemic journey. At the same time, of course, the injection will flow from the starting point back into the efferent vessels of the organ of Bojanus.

I have not succeeded in continuing the pressure long enough or steadily enough to make the fluid pass on into the vena cava; the small systematic vessels seem to offer so much resistance that the injection is pretty sure to make a break somewhere before it finally succeeds in making its way through them; and in the same way the renal vessels fail to transmit it backwards into the vena cava. It is very likely that a steadier hand than mine might succeed better, or that an injection controlled by the force of gravity might be made to demonstrate the complete and orderly circuit of the blood around to the starting point; but even the injection of two-thirds of the entire circuit and the gradual progress of the fluid from point to point is instructive. Goodwin D. Swezey.

Doane College, Crete, Nebr.

Protective Mimicry of a Moth.

A correspondent of "*Science*," August 4, notes a case of protective mimicry of a moth. From the brief description given, the insect may be the Red Humped Apple-tree Caterpillar Moth, *Oedemasia concinna* which has just been reared from larvæ, at the University of Kansas, where work is being done in an economic and biologic collection of insects. About a dozen caterpillars were received from Delphos, Kansas, July 19, and after preserving two or three in alcohol, the remainder were put in breeding cages with apple leaves for food. By July 13, all had pupated, some going into ground at surface, while the majority made thin cocoons among the twigs and leaves in such manner as to be completely enveloped and hidden. Adults emerged by August 14, and then it was noticed how easily they could be mistaken, while clinging to the limbs of trees, for short stubs of broken branches, and thus cheat their enemies out of a meal.

Taking this as the same species as described and figured in the article, it may be noticed that the distribution is wide, Ohio to Kansas, though it may be expected wherever apples are grown. From the adults, several lots of eggs were found on underside of leaves, and their development will be watched. E. S. Tucker.

Lawrence, Kansas, Aug. 16.

Explosive Gas in Locomotive Engines.

In the article on p. 79 of *Science*, Aug. 11, 1893, concerning "Explosive Gas in Hot Water Apparatus," are some very pertinent questions to which I would like to add several in regard to high-pressure engines.

Assuming the facts stated as true, as they probably are, in the case of heating furnaces in houses, may they not be true also in, for instance, a locomotive engine under certain circumstances?

May not the hydrogen in a locomotive become mixed with common air?

May not this mixture be exploded under certain circumstances likely to occur in locomotives?

May not this be the real explanation of those sudden and terrific explosions that occasionally occur, where no apparent cause can be assigned? M. W. V.

Ft. Edward, N. Y., Aug. 16.

Coyote or Bear?

Coyote or bear? "that is the question" which has apparently agitated Dr. Franz Heger, Curator of the Ethnographical Museum at Vienna, ever since Mrs. Zelia Nuttall, Special Assistant in Mexican Archæology of the Peabody Museum, Cambridge, Mass., described and figured an ancient Mexican shield inlaid with feather-work and gold and bearing an animal device of a blue "monster" on a red field. (Internationales Archiv für Ethnographie, Vol. V., Part 1, 1892).[1]

This shield Mrs. Zelia Nuttall found preserved at Castle Ambras, in Tyrol, and, recognizing its unique character, obtained permission from the Imperial Oberhofmeisteramt at Vienna to have it sketched and photographed. It proved to be an ancient Mexican feather-work shield, with an authentic history, like the head-dress of the time of Montezuma, still exhibited at Vienna, "unfortunately always upside down." This was restored by Dr. Ferdinand von Hochstetter and described by him as a standard or banner.[2] Both head-dress[2] and shield were sent by Cortez to Charles V., and subsequently formed part of the historical collection of armor formed by his nephew, the Archduke Ferdinand of Tyrol, and were duly recorded in the Inventories of that famous collection. Strangely enough, the shield was supposed to be lost, and Professor Hochstetter lamented "its total disappearance." All the while it was lying *perdu*, in a case labelled "Transatlantic and Oriental Curiosities," at Castle Ambras in Tyrol, until its importance was recognized by Mrs. Nuttall on a chance visit to the Museum Ambras. Soon after Mrs. Nuttall announced the continued preservation and whereabouts of this valuable Ancient Mexican relic to the Anthropological Society of Berlin, and the shield was consequently removed to Vienna. Some other Ancient Mexican objects were also transferred there at the same time, and these Dr. Franz Heger has described in a memoir published in the Annals of the Imperial Natural History Museum of Vienna, 1892.[3]

It is not altogether surprising that the Austrian curators should have felt a little sore that the real history of so valuable a relic should have been forgotten, although the specimen was duly taken care of, and that its whereabouts and unique value should have been made known by a foreign visitor and Mexicaniste scholar. But that is no reason why Mrs. Zelia Nuttall's critical and searching investigations on "ancient Mexican shields" in general, and the Ambras shield in particular, should be misrepresented and misquoted. Any one reading Mrs. Nuttall's original memoir, and Dr. Heger's more recent article, cannot help seeing such to be the case. For instance, Dr. Heger curtly states, "According to Z. Nuttall the mon-

1. See "Ancient Mexican Heraldry," by Agnes Crane. Science, Vol. XX., No. 503, Sept., 1892.
2. "Standard or Head-dress," by Zelia Nuttall, Peabody Museum Papers. Vol. I., No. 1, 1888.
3. Altmexikanische Reliquien aus dem Schlosse Ambras in Tirol.

ster on the shield represents the fabulous Ahuizoltl, or water animal," whereas, while duly considering the possibilities of such identification, Mrs. Zelia Nuttall stated, in conclusion, "that she was prevented from upholding it," and drew attention to the resemblance between the outlines of the Ambras "monster" and those of the coyote or prairie wolf, as depicted in the Codex Mendoza to express ikonomatically the name of the Pueblo *Coyohuacan*—place of wolves. Dr. Edward Seler subsequently endorsed Mrs. Nuttall's identification of the Ambras monster as a coyote or prairie wolf.

Dr. Heger, however, declines to recognize the device as representing a wolf, and declares it to be a bear from "its fangs, claws and shaggy coat,"—characteristics, by the way, also common to the wolf. He admits that "the tail is rather long for a bear," but adduces, in support of his hypothesis, the fact that bushy tails are possessed by the smaller species of bears, and proceeds to evolve from his inner consciousness a Mexican species of small, long-tailed bear, unknown alike to ancient Mexican pictographers and more prosaic but exact modern zoölogists. Such authorities as Wallace[4] and W. H. Flower[5] state that only one species of bear, *Ursus ornatus*, is known to occur in the Neotropical region, which includes the American continent from the northern limits of Mexico to Patagonia, and that species is the spectacled bear, restricted to the Chilian sub-region.

Is it possible that Dr. Heger confused the *true bears* (Ursidæ) with the raccoons (Procyonidæ) familiarly known in Germany as "Waschbären," from their singular habit of washing their food. These, however, are not bears but small *bear-like* animals with long tails, commonly annulated. These raccoons do occur in Mexico, but they are characterized by "turn up" noses, which give them a mild and inquisitive appearance, differing widely from the wolverine aspect of the Ambras "monster," which looks as much like a wolf rampant with protruded claws as heraldic designs with that intent in general. The feet of the coyote or prairie wolf are more correctly indicated in the pictograph of the coyote from the Mendoza codex. The bears are flat-footed and cannot retract their claws, which form the only ursine feature of the Ambras monster.

Dr. Heger's fallacies, misquotations and self-contradictions are amusingly exposed by Mrs. Zelia Nuttall, in the current number of the *Internationales Archiv fur Ethnographie*, Part 6, 1893. To use a familiar metaphor, it will be seen that the lady has left neither Dr. Heger nor his hypothetical, long, bushy-tailed, small *Mexican bear* a leg to stand upon. *Fac-similes* of both the Ambras shield and the feather head-dress of the time of Montezuma are exhibited in the Ethnological Department of the Chicago Exposition. We believe Mrs. Nuttall is about to enter on the official duties connected with her appointment as "Judge of ethnological exhibits in the Women's Department," to which she has been recently nominated.

Agnes Crane.

Brighton, Eng.

4. "Geographical Distribution of Animals," Vol. II., p. 201.
5. "Mammals Living and Extinct," p. 565.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For exchange—Complete set of serial slides of embryo chick, 12 to 72 hours old; of rabbit 10m long, and various stages of development of tadpole, mouse and rat. Will sell or exchange for botanical slides, or books or photographic apparatus. D. T. MacDougal, University of Minnesota, Minneapolis, Minn.

For sale or exchange.—A fine collection of Lepidoptera, native and exotic. For particulars address Addison Ellsworth, Binghamton, N. Y., care Republican.

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U. S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | — will exchange for any works or pamphlets on American Slugs or Anatomy of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

I wish to exchange a New Model Hall Typewriter, price $30, for a Daylight Kodak, 4x5 preferred. George A. Coleman, Dep't. Agric., Div. of Ornithology, Washington, D. C.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St., Newark, N. J.

Wants.

I WOULD be grateful to receive replies to any of the following questions.—Is copper found native in Mexico? Is it found native in Cuba? If so, in either or both cases can I purchase authentic specimens? Can any one furnish me with results of analyses of native Mexican or Cuban copper, also analyses of unalloyed copper reduced from the ore from Cuba or Mexico? Is it possible to procure aboriginal implements of copper from Cuba or Mexico? Answers to these questions will greatly aid the preparation of a report for a scientific institution. C. B. Moore, 1321 Locust St., Philadelphia, Pa.

A YOUNG woman who has been an assistant for a literary and scientific man desires a similar position. Is an experienced and accurate stenographer and typewriter, thoroughly educated, and sufficiently familiar with literary work to write, independent of dictation. Has some knowledge of the Spanish language. Will go to any part of the United States. Address, Box 147, Ravenna, Ohio.

A GRADUATE of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

WANTED.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

QUERY.

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

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N. D. C. HODGES, 874 BROADWAY, N. Y.

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SCIENCE

NEW YORK, SEPTEMBER 8, 1893.

THE MARINE BIOLOGICAL LABORATORY.

BY DALLAS L. SHARP, BRIDGETON, N. J.

The sixth summer session of the Marine Biological Laboratory, at Wood's Holl, Mass., ended with August '93, and a short review of the station, of its work and growth, will be of interest to *Science* readers, throughout the country, who are at all interested in our advancement in biological thought and investigation.

The phenomenal growth and spendid proportions of the Marine Biological Laboratory, as it now stands, justly deserve the interest and admiration of every educated American.

Starting six years ago, in 1888, the Laboratory was but a single building of two large rooms, poorly equipped for work, with only one boat for collecting material, and a total of seventeen students. The session of '93 opened with three connected buildings more than twice as large as the original, containing thirty-four private rooms, a lecture room, a library, a supply department, five general laboratories, and a total of one hundred and twelve students. Instead of a single row-boat, there are now several at the Laboratory's wharf and beside these a splendid Burgess-built steam launch perfectly equipped for collecting and always at the students' command.

The secret of this extraordinary growth is mainly due to the Laboratory's ideal foundation, its location, its officers and the high grade of its work.

In 1881, at Annisquam, a quaint little fishing village on Cape Ann, the Woman's Educational Society of Boston started a small laboratory for the study of marine zoology For six years investigation was carried on here, with constantly increasing demands for *better* and *more* accomodations, until the necessity of a permanent and better equipped laboratory brought together a number of Boston scientists, who were organized into a corporation under the name of the Marine Biological Laboratory.

Thus it came into existence, and though started in Boston it is by no means a local institution. It can hardly be called national, for students from Maine to California work side by side with those from England, Germany and Japan. Its board of trustees includes a large proportion of America's most prominent scientists, and their aim is to make the Laboratory an institution second to none of its kind in the world.

The location of the Laboratory at Wood's Holl is most happy. It was not the result of luck or chance. Over twenty years ago the late Professor Spencer F. Baird, of the Smithsonian Institution, recognized the advantages of Wood's Holl for the study of marine life, and for many years he and his assistants came here and worked through the summer months. As a result of his work, the United States has established here her most important fishing station, whose buildings are the finest of their kind in the world. Nowhere along the Atlantic coast do the American waters offer more varied or richer fields for the naturalist.

Looking off to the southward from a Laboratory window, Martha's Vineyard is seen stretching away in the distance till its point is lost behind Nonameset, which in turn is followed by Naushon, by Nashuena, by Cuttyhunk and others. Behind to the west lies Buzzard's Bay with its distant shore and the little Weepecket Islands like dots upon its surface. In front again is Vineyard Sound, the Harbor, Wood's Hole, Quick's Hole, and other holes innumerable, all teeming with life and all within easy reach of the student.

What a happy hunting ground! What variety of forms! What wealth of numbers! What a paradise for the naturalist! The sandy shores, the rocky points, the muddy bays, the tide-pools, holes and bottoms from the depths in Vineyard Sound to the shallows of Buzzard's Bay, are all astir with life which the student may study at first hand.

After a year's study at the Laboratory the average student wakes up to the fact that he never knew before what the study of zoology or botany meant.

He is no longer looking at "stuffed things" wired fast to sticks, or withered, shrunken, faded stuff in glass bottles.

The specimens are not stuffed with tow nor wired to the rocks, which he gathers from the shores at Wood's Holl, nor do thy float around in alcohol. He learns many new names, but does not spend the summer committing to memory the check-list of species on the coast. He returns to his teaching or college with a larger idea of life; to his reading and work asking how and why and when. He returns to every thing with renewed vigor and enthusiasm, except to the college museum.

The work done at the Laboratory is divided into two very distinct divisions. The institution is at once a centre for the advancement and for the diffusion of knowledge; it is a school for teaching and a station for research: and acordingly the students who annually attend are divided by a distinct line into pupils and investigators. In the first category come those who have had but an elementary course in zoology, who are practically unacquainted with the methods of work, who must needs have a broad and general knowledge of the structure of the various groups of animals, must become acquainted with the great principles of biology, and the use of the naturalist's instruments, before they can engage in original research.

For the needs of this class of students the Marine Biological Laboratory is eminently fitted. In no other institution of its kind has this department been so carefully and thoroughly developed. The Marine Biological Laboratory is unique in this. It stands alone. It is an entirely new departure, and the student who intends to teach or work in any line of biological investigation has an advantage here that is entirely without equal.

Each student has his regular table, his locker for instruments, his own reagents and complete outfit for work. In the centre of the room are the aquaria where his living material is kept. Here he may work, as long as he likes, with abundant material, free to ask questions, and with some eniment biologist always at hand in case of difficulty.

The instruction is largely personal. From 9 till 10 A. M. there is a general lecture, bearing on the form that is to be studied that day. This lecture is always given by some specialist in that particular group. To-day, for instance, the form under study will be a sponge; the morning lecture then will be by some investigator who is making sponges his special study. After this lecture the day is given up to study, and the instructors are always near, with criticism and suggestion, clearing away the difficulties as they arise, until the student, working form after form, gradually masters the technique and learns in part to interpret facts for himself.

After this course, if he chooses to return another year and persue the work further, he takes a table in the upper laboratory, where he is given some problem to solve, which is not too difficult, and here again he is helped over the hard places, until, having had sufficient preliminary training, he is capable of choosing and solving his own problems.

For those who carry on special investigations private rooms are provided, where they may work undisturbed and in perfect quiet.

This year there are thirty-four of these rooms, each occupied by some investigator, working at some problem whose solution will have an important bearing on the scientific thought of the day.

This summer gathering of our biologists and scientists at the Marine Biological Laboratory, apart from the natural advantages of the place, is of the greatest help and importance. There is an enthusiasm and stimulus in the numbers and personal contact which nothing else gives. Men of different schools, working in widely separated fields, here meet and compare ideas and methods. Their lines of work continually cross and the help of a specialist's suggestions at these points cannot be overestimated. Hardly a paper goes to press, but that it has first received the honest judgment and criticism of those whom the author most wishes to reach.

Every point of interest and doubt is carefully weighed and discussed, and very seldom does error escape detection. As often happened this year, papers which have been long in preparation, and discoveries that are entirely new, are delivered as lectures before the whole student body, and are afterward discussed, allowing every one the privilege of expressing his criticism and opinion. This is not only of immense value to the author, but all present are thus kept in the very van of scientific thought.

The student who wishes to come to Wood's Holl does not necessarily need to be working some problem of marine life, to enjoy the advantages of the Laboratory. His work may be such that requires the fresh-water ponds, or the woods and fields, it may be; if so, they are all at hand. The character of the surrounding land is almost as varied as that of the water. The green and rolling hills, the winding road-ways, the quiet, shady ponds,—all combine to make the country round about Wood's Holl a land of delight to the summer visitor, whether he be student or pleasure seeker.

One of the newest features of the Marine Biological Laboratory is the Department of Physiology. This was first opened last year under Dr. Jacques Loeb, of the University of Chicago. This year professors from Harvard Medical School, the College of Physicians and Surgeons, from Johns Hopkins and other such schools have occupied the rooms and have placed the department on a sure and successful footing.

The Botanical Department gave a course in Cryptogamic Botany in reference to marine algæ and a parallel course in comparative forms of Fungi. The department was crowded, several specialists investigating problems connected with marine plant-life.

The "Supply Department" of the Laboratory, while it is a side issue and of no special concern to the summer student, is nevertheless an institution of great interest and importance to every zoological teacher in the country. The collecting is under the care of Mr. F. W. Wamsley, who has had much experience in the work, and he has reduced the business of collecting, killing and preserving, to a science.

Full data accompany every specimen. The date, even the hour in some cases, the location, depth of water, character of bottom, and many other minor details, are carefully noted. Then the killing fluid is tested and proportioned, and so on through every step in the process of fixing the tissues, which is often very complicated, until the specimen is finally preserved in the proper alcohol. As the value of a zoological specimen preserved for class use, or for histological purposes, depends entirely upon the methods used in its preservation, it should be, and is, a source of great satisfaction to know that the Marine Biological Laboratory has established a department where such material can be supplied, which formerly could not well be had short of Naples.

The excellent library of the Laboratory is at all times open to the student. The Laboratory is a regular subscriber to about thirty of the leading biological and other scientific papers of our own and foreign countries. Besides this, the Boston Society of Natural History has generously placed the use of their library at the disposal of the Laboratory, and the library at the Laboratory has been in this way effectively supplemented.

The evening lecture course for the session of '93 was like that of former years, dealing mainly with subjects of general interest. Night after night the little lecture room was crowded with the students and their friends and the people from the village.

Such, in brief outline, is the Marine Biological Laboratory at the close of its sixth year.

We are justly proud of what it has been and now is. Its short history is one of severest struggle. What it now is, is owing to the generosity and earnest labor of a few; what it is to be, depends, in part, on your generosity and mine. What it *may* be, is summed up in these few words from the last report of its director, Dr. C. O. Whitman, "We have now seen about the limit of what can be accomplished without funds. The two functions of instruction and investigation have worked admirably together, each growing stronger in the success of the other. We have endeavored to keep the two properly balanced, but I think we have nearly reached the limit of our capacity for instruction with our present space and means. We already see that to tax our teaching forces much more, would not tend to improve the side of investigation. For further development, then, two things have to be provided, namely, *room and funds*. As we cannot well enlarge our building, and as the conditions for both branches of our work could be immensely improved by providing a separate building for the investigators, our next step is clearly defined: It is a suitable observatory for the exclusive use of those engaged in original research. Preparatory to this, a site is to be selected and secured. This done, the plan of the building worked out, the equipment estimated, the income necessary to the maintenance of the observatory, with its officers and scientific staff ascertained, we shall be prepared to lay the whole matter before any one who may be disposed to contribute to the foundation of a biological observatory—an observatory which shall be an honor to America, and worthy of that promising science of the future to which the world looks for grander discoveries than have yet enriched human knowledge or contributed to the welfare and advancement of the race."

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

HOW CHEMISTRY IS BEST TAUGHT.*

BY CHARLES F. MABERY, CASE SCHOOL OF SCIENCE, CLEVELAND, OHIO.

THE subject "How chemistry is best taught," which has been proposed to us for discussion, has a serious interest for all persons who are engaged in teaching chemistry, and it is of especial importance to those of us who have in charge the preparation of young men for professional employment. In view of the prominence of scientific subjects and methods in the present systems of education, it is incumbent upon the adherents of these methods to demonstrate by their results that they are not in error in assuming that science should have an equivalent place with other departments of knowledge. In the higher institutions this question has received a definite answer; in the secondary schools evidently much has yet to be accomplished in the direction of general education as well as in the preparation for higher study.

That the importance of a knowledge of elementary chemistry is apparent to all who are capable of appreciating its usefulness, is evident in the recent extension of instruction in the secondary schools. In the larger portion of our high schools, however, physical science still occupies a subordinate place, or it is taught merely from text-books with little, if any, laboratory training. Probably the chief hindrance to any radical change is a lack of appreciation on the part of the public. If parents could be brought to see that their sons and daughters would receive a better education if physical science properly taught formed an essential feature of the high school course, the change would not be long delayed. That the training of many teachers is scarcely more comprehensive than they are called upon to impart is of less importance, since at present those who are educated in the higher institutions have better opportunities, and those who are deficient can improve their knowledge in special courses for teachers. Doubtless the many popular movements of the present day will exert a beneficial influence in extending an acquaintance with the application of scientific principles. Such unique and instructive object lessons as that which has been designed, under the direction of Prof. Ellen H. Richards, for the Rumford kitchen, in the Columbian Exposition, cannot fail to attract public attention. It requires no particular training in observation to recognize the difference in nutrition of foods which have a widely different nutritive value; but when an appetite whetted to the sharpest edge in an endeavor to see all the exhibits in the Liberal Arts building in one visit, and the unavailing efforts to extract a crumb of comfort from the places so improperly named, is brought in contact with the wholesome dishes prepared in the Rumford kitchen, and their satisfying influence, the numbers representing the food values will be in a favorable connection to awaken a desire for further information. The same principle is applied in a different manner in the exhibits from the agricultural stations which explain the composition of dairy products, of animal foods and the methods of chemical investigations. These exhibits have a particular interest for persons engaged in agricultural pursuits since they are a part of the well-directed efforts of the stations in disseminating knowledge. Probably in no department of education has there been a more substantial growth during the last twenty years than on the part of intelligent farmers in applying the practical information coming to them from the results of investigations carried on at the experiment stations. These illustrations may seem somewhat removed from the main question before us, but I am convinced that the efficiency of higher instruction in chemistry will be greatly improved when students coming to us from the secondary schools shall have had the advantage of practical training in elementary physical science, and I believe this will be the sooner accomplished through a recognition of its benefits in the affairs of every-day life.

I think we shall all agree that the best argument to be urged in favor of a prominent place for chemistry in any grade of instruction is the value of experimental methods for the development of mental power. This feature should naturally appear with especial prominence in courses leading to the degree of Bachelor of Arts; and if the schools of science are to be maintained on a higher plane than the trade schools or shops, the courses of study must be conducted with reference to the attainment of mental discipline and scholarship. In the courses in chemistry I am unable to see why this should interfere with the acquisition of practical knowledge.

The guiding star to successful teaching in chemistry is the personality and enthusiasm of the instructor. With the great increase in attendance in many institutions the earlier relations between student and instructor, which were frequently mingled with deep personal feeling, somewhat akin to veneration on the part of the student, are well-nigh impossible. Nevertheless, an enthusiastic teacher with tact and good judgment has little difficulty in maintaining a profound interest even in large classes. In successful teaching we all know how much depends upon the attitude of the instructor toward his students. Courteous relations, with a clear understanding that teacher and students are mutually interested in the acquisition of knowledge, readily secure the confidence and esteem of a body of students, and the instruction need seldom be interrupted by questions of conduct. A faithful teacher does not limit his attention to the brighter minds; students slow in comprehension but earnest in application secure a store of information which will be used later to the best advantage. It was a wise teacher who said: "I am faithful in my duty to dull students; in my old age I may need favors of the men of wealth."

In assimilating their methods from European laboratories, the chemists of the United States, untrammelled by traditions and unrestrained by the influence of any particular school, have been in favorable conditions to appreciate the labors of the great masters of other countries. Unfortunately, it may be, in the wonderful development of our natural resources, the temptation to enjoy material benefits may have retarded the growth of orig-

*A paper read before the section of Didactic Chemistry in the World's Congress Auxiliary of the World's Columbian Exposition at Chicago, August 26, 1893.

inal investigation; yet looking toward the future the erection of so many large laboratories cannot fail, under judicious control, to contribute to the advancement of knowledge. A marked individuality in our methods is apparent even in a casual inspection of American laboratories. Variation in details is a natural consequence of differences in the temperament of different peoples; and teachers educated abroad have perceived the necessity of adapting the methods in which they were trained to the peculiar conditions.

With some hesitation I approach that aspect of our subject which relates to the details of methods, since the best success in teaching is so dependent on the personality of the instructor that it would seem presumptuous to suggest a rigid scheme for all. There are certain principles at the foundation of successful teaching, however, which may properly be presented for consideration, especially since this paper is intended as an introduction to general discussion. I have already alluded to an unsatisfactory condition in the methods employed in the secondary schools. In some of the high schools, as we all know, there are teachers who are thoroughly imbued with the spirit of scientific study, yet competent teachers are often limited in their efforts by a heavy burden of other work, or by a need of the necessary appliances. There can be no question that the high school courses would be benefitted if every pupil received systematic training in elementary physical science, and I believe it is consistent with due attention to other subjects, and that it can be accomplished without any unreasonable pecuniary burden. As an expeditious and effective method for teaching chemistry in the high school, I would have the teacher meet the class before the lecture table and demonstrate, experiment and explain, simply as a convenient mode of teaching classes as one pupil should be taught. The experiments should be repeated by the student in the laboratory, under the immediate oversight of the teacher, with the note book close at hand. A text-book is necessary, to give information which the teacher has not time to include; but no text-book can supply the need of personal teaching. Occasionally teachers with limited knowledge are led to adopt methods of questionable utility by the arrangement of certain text-books. Some years since a teacher in one of the high schools in the East, in which little attention was given to laboratory work for students, remarked that his pupils must have a thorough knowledge of valence and structure symbols. The topical arrangement of the subject may be left to the discretion of the teacher, and the quantity to the length of time available; but it should never be forgotten that the educational value of such instruction depends upon the development of skill in manipulation, of correct habits of observation and in recording notes, and of the true spirit of scientific thought. Whatever of practical information may be included will enhance the utility of the instruction.

In the higher institutions the first course is general and descriptive chemistry, of which every person who expects to engage in any scientific pursuit should have a thorough knowledge; and, as has been suggested, this subject should have a suitable place in college courses. Concerning details of the most efficient methods in teaching general chemistry, no doubt an extended course of experimental lectures, closely connected with laboratory practice, affords the best training. The ground can be fairly covered in seventy or eighty lectures, with four to six hours a week of laboratory work, so arranged that the lectures of each week shall include the experiments for the laboratory. Weekly recitations on the subjects of the lectures and laboratory work enable the instructor to control the progress of his students. When students first enter the laboratory it is essential that they are impressed with the necessity of accuracy in the details of experimental work. This important lesson may easily be taught by means of experiments capable of affording quantitative results; by some instructors such experiments are occasionally introduced throughout the course, with the same object in view. There should be sufficient instruction in the laboratory for careful oversight of the experimental work and the note book of each student. Moreover, I am convinced that it is unwise, in any grade of undergraduate study in chemistry, to allow students in laboratories without constant supervision; when left to themselves they are apt to loiter, to contract careless habits and to waste material. Then a laboratory is held responsible for accidents, even though they occur through inexcusable carelessness of students. Every instructor in charge of a laboratory will, no doubt, recall heedless moments on the part of students. Some years ago, just as I entered my qualitative laboratory one day when the assistant was out of the room, I observed a student inflate his lungs twice from a bottle containing a freshly charged solution of hydric sulphide; he immediately fell into the arms of a companion, and it was some time before he recovered. Probably another inflation would have proved fatal.

This fellow was a sophomore, having taken one year in general and descriptive chemistry; he was fairly bright and had been using this reagent during several months. But some question arose as to the odor of the unadulterated gas, and, forgetting the precepts of his freshman year, he attempted by a direct experiment to ascertain the truth. What has been said concerning the personality of the instructor applies, perhaps, in a more restricted sense to the student. While methodical habits are to be strenuously insisted upon, the methods may be sufficiently flexible to allow the student to reach his conclusions in his own peculiar way; the particular form of the lecture and laboratory notes, for example, can be left to the preference of the student, provided they are well written and complete.

For other students than those who desire special training in chemistry or in allied subjects, an extended course in general and descriptive chemistry provides ample knowledge of this subject. Analytical chemistry is next in the sequence of studies, and for evident reasons qualitative analysis is first undertaken. On account of its great disciplinary value I regard this subject as one of the most important in the whole course of chemical training. It enables the instructor constantly to test the faithfulness and proficiency of the student, and beside the mental discipline, the student acquires a comprehensive knowledge of methods of separation and identification, which is the foundation of quantitative analysis. Elementary theoretical chemistry, or chemical philosophy, may be conveniently and profitably taught at the same time with qualitative analysis, especially since a familiarity with stochiometry and chemical reactions is essential in a good understanding of quantitative methods.

Thus far, in teaching chemistry, probably the methods are not materially different in the college and the technical school. Indeed, in the more advanced subjects, the principal difference is in the attention which should be given to the acquisition of practical knowledge in the technical courses. The methods of quantitative analysis are well adapted for the development of skill and dexterity in accurate manipulation, and to the chemist they are indispensable. As a preparation for professional employment the training in methods should be sufficiently comprehensive and thorough to enable the student to appreciate the conditions of any analytical problem; and, further, I deem it of much importance that students have practice, under guidance, in all typical standard methods.

It is not sufficient that men are carefully trained in methods which impart skill and accuracy; it seems more desirable, for example, that men who enter the iron and steel industry are thoroughly familiar with the standard methods of iron analysis than to rely upon skill and general knowledge to acquire the special features in actual practice. The first lessons to be learned in the quantitative laboratory are accuracy and confidence; the importance of a close economy of time and effort must be appreciated, and an intelligent student will soon perceive the numerous ways for conducting analytical operations rapidly without haste. When a chemist assumes the duties of a position every motion has a pecuniary value, and results are demanded in the smallest limit of time. This requirement is sometimes urged in favor of undergraduate training in rapid methods. While some practice in this direction would, without doubt, be serviceable; in three terms, at most, which can be devoted to quantitative analysis, the time is fully occupied in gaining a familiarity with methods, and in passing from one analysis to another the conditions are not favorable for commercial rapidity. As in actual practice it is only possible to attain to the highest degree of accuracy and celerity when the attention of the analyst is limited to a moderate number of determinations which are continually repeated. Experience shows that well-trained students are not long in acquiring commercial dexterity, even to reporting the percentage of carbon within five minutes after a ladle of steel is poured into the mould, or a complete analysis of blast furnace slag within thirty minutes. If attempts were made to give such practice to students, there would still be much to learn in the different conditions in the laboratory of the manufacturing plant.

A branch of our subject, which has doubtless occasioned some of us much perplexity in our endeavors to give it a suitable place in an undergraduate course, is organic chemistry. Our difficulty is partly due to the feeling on the part of certain students when they have gained a good acquaintance with quantitative analysis, with the consciousness that they can secure some pecuniary return from their attainments, that they have learned all of chemistry that can be of service to them. Usually such students may be made sensible of their error, although, unfortunately, the importance of a broader view is not always appreciated until a knowledge of this subject is needed in professional occupation. That organic chemistry is a difficult subject students are not long in perceiving. It is not sufficient in a course of lectures that the principles and methods are understood, they must be learned. The importance of a broad and thorough training in theoretical and descriptive organic chemistry as a part of a chemical education is beyond question. As a part of the preparation for technological and applied chemistry, organic chemistry can most conveniently be placed in the third year; yet without some introduction I have found this subject too difficult for third-year students. The plan which I have adopted with satisfactory results includes recitations in the first term of the third year from an elementary text-book, with the following lectures extending throughout the second term and the first term of the fourth year. So far as possible laboratory work should accompany the lectures, although from the pressure of other work the greater portion of the experimental work may be pushed forward into the fourth year. In connection with the lectures, students should be required to extend their knowledge by reading, and recitations are necessary to ensure faithful application. With this arrangement the principal laboratory work of the fourth year includes organic chemistry and chemical technology, assaying, gas analysis; and such other special subjects as may seem expedient can be provided for here. A course of lectures in metallurgy are of advantage to students in chemistry, and they may be attended during this year; some additional instruction in theoretical chemistry can be given with profit.

For the utilization of chemical skill the field of manufacturing or applied chemistry is full of promise, although in this country it has largely to be developed. Suitable preparation for industrial occupation demands thorough training in the directions already suggested, and beside, a good knowledge of technical processes with the aid of laboratory work, so far as it is feasible to experiment with these processes on a laboratory scale. Concerning the best methods for teaching this subject, no doubt courses of lectures, supplemented by reading, are to be preferred, especially if part of the lectures can be given by persons engaged in professional pursuits. Several recent compilations, in a convenient form for the use of students, are a valuable aid.

The range in laboratory work is of necessity somewhat limited; it must consist principally in the preparation of chemical products from crude materials, in the study of mordants and dyes and in testing the efficiency of certain features of industrial processes on a laboratory scale. The preparation of theses or written accounts of various processes should also form a prominent feature of a course in technological chemistry. Institutions fortunately situated near manufacturing establishments, afford valuable opportunities to students, who are enabled to study industrial methods in actual operation. Such instruction, supplemented by laboratory practice, constitutes the best possible education in applied chemistry that an institution can provide.

Any discussion of the details of a chemical education must be incomplete without some reference to related subjects, either such as are closely allied to chemistry, or those which are essential in the proper mental development of every well-educated person. Evidently this portion of our subject may be considered from more than one point of view. In a course of four years in the school of science, there should be thorough training in mathematics, so far as calculus, and it can be no disadvantage to make a certain portion of this subject required or optional. Every chemist who aspires to a position beyond that of an analyst will be called upon to plan and oversee the construction of appliances and buildings; in fact, ingenuity and mechanical skill may occasionally be as serviceable as chemical knowledge. There are, therefore, good reasons for the acquirement, by every student, of a good understanding of mechanical drawing and of elementary mechanics, and this may have led to the foundation, in several institutions, of a course in chemical engineering. No doubt this course is in demand by persons who desire proficiency in the engineering features, but students who expect to engage in applied chemistry can hardly afford to omit any portion of the undergraduate training in chemistry. Nothing need be said as to the importance to all chemists of a thorough discipline in descriptive physics with laboratory practice. A familiarity with the principles of heat and electricity and with the manipulation of electrical currents are among the more important requisites. The rapid growth of electro-metallurgy indicates large possibilities for the application of electrical energy in this form, and it can evidently best be undertaken by the chemist who possesses a good knowledge of electricity. The literary training in scientific courses is usually limited to the English branches and the modern languages; without a certain acquaintance with the latter the chemist would be seriously restricted in the sources of his information; and, moreover, to scientific students, it would seem that the French and German languages should be taught as much, at least, for mental discipline and culture as for their practical usefulness. Of the importance of thorough discipline in the English language and literature, history, logic and political economy it is not necessary to speak. Determinative mineralogy may be provided for in the second or third year. Courses in agricultural or pharmaceutical chemistry, or in other special fields, should differ in the details of the third and fourth years from the course outlined above.

In college and university courses, theoretical chemistry and chemical literature receive more attention, and in general less attention is given to practical applications. I do not accept the idea sometimes expressed, that original investigation should not be attempted outside of the university. We are all too well aware of the difficulties in the way of carrying on special study in connection with the responsibility of undergraduate courses; and yet I am sure we appreciate the influence of such work in the atmosphere of the laboratory, as well as upon the instructor himself. Then there are always in the laboratory bright students who are able to undertake with profit the study of special problems. As a part of the preparation for teaching I look upon a certain acquaintance with the methods of original research as an essential attainment; I do not intend to assert that without it there can be no good teachers, but it certainly strengthens the equipment of a teacher who aspires to a high position.

Earlier in this paper I endeavored to give an outline of what seem to be the principal objects to be kept in view in teaching chemistry as an educational subject. Students continue in chemistry with the intention of securing professional employment either in teaching or in applied chemistry. How often are we met with the question as to what is the prospect of employment after graduation; whether the inducements are more promising in teaching or in practical fields. Concerning teaching as a profession, the reply is easy: a person with an aptitude for teaching and with broad training has little difficulty in securing a position commensurate with his attainments, especially at present, with the wonderful extension of our educational institutions. But the number of positions is limited and there are few vacancies; if they were abundant not all persons, even with the best possible preparation, would succeed in teaching chemistry. In applied chemistry the conditions are not the same. With our enormous stores of natural products yet undeveloped, vigorous enterprise in business operations and great industrial wealth, there cannot fail to be rapid developments in the fields of manufacturing chemistry. Within the ten years just elapsed we have witnessed great changes; manufacturers who, ten years ago, conducted their operations almost without the aid of chemical skill, now employ several chemists. Eight years ago I visited a large plant for the manufacture of sulphuric acid, which contained neither a Glover nor a Gay Lussac tower. Further improvements, which are necessary for the production at home of the chemical products that are now imported in large quantities, require broad qualifications with extended experience; if our graduates are not sufficiently well trained chemists will be secured elsewhere.

If there are portions of the educational field in chemistry which appeal to us with greater force than others, perhaps the elementary teaching in the secondary schools and the advanced study in preparation for teaching or for positions requiring independent skill and originality in methods are worthy of attention. The recent growth of knowledge within special fields has introduced new features into methods of instruction. In addition to courses which are adapted for all students, those who intend to undertake investigations in any particular direction should have training under the guidance of a specialist in that field. There are many economic problems of the utmost importance awaiting solution, which require not only the application of all accumulated knowledge, but the discovery of new methods. The maintenance of a healthful water supply and the economic disposal of sewage are serious problems for the present generation, and the engineer must be aided by the best skill of the chemist and of the bacteriologist.

Every laborer is directly interested in the promotion of investigations on an economic and healthful food supply. To the great army of workmen who are struggling to support families on incomes of three or four hundred dollars a year it is a matter of serious importance to secure the best nutrition at the smallest cost. Yet it is rarely, if ever, that a judicious selection of food materials receives attention; it is usually a question of individual taste, so far as the means at hand will permit, with a complete ignorance of any principles of economy or health. In these directions and others of no less importance there are great opportunities in the domain of sanitary chemistry to render inestimable benefits to humanity.

What has been said of sanitary chemistry applies with equal force to medical chemistry, to agricultural chemistry and to other special fields. But I feel sure that the details of methods of instruction, as well as a consideration of methods based on other recent discoveries, such as the use of models in teaching structural chemistry, can best form a part of the general discussion by teachers who are especially occupied in those particular fields. Perhaps, also, the great border land between chemistry and physics, or chemical physics, should receive attention from those whose investigations are extending our conceptions of the fundamental principles of chemistry.

If I have presented this subject more especially from the standpoint of the preparation for professional occupation, it is because this seems to be the principal demand for instruction in chemistry beyond the elementary branches. But if the value of training in chemistry as a factor in liberal education has not been set forth with due prominence, it should receive just consideration in the discussion which follows. I have not attempted in this paper to include methods or conditions outside of our own institutions; yet we cannot fail to derive great benefit in extending our knowledge of the methods in other institutions through the eminent professors with whom it is our good fortune to meet.

NOTES ON THE WOOD OR FALLOW ANT OF SOUTHEASTERN MASSACHUSETTS.

BY J. B. WOODWORTH, CAMBRIDGE, MASS.

Anecdotes of the ant form, apparently, a large part of the minor contributions to journals of natural history. The fact that so many stories have been published, and the hope that the following will interest some student of the psychological habits of ants, encourage me to relate two observations of my own upon the behavior of the large Wood or Fallow ant (*Formica rufa*, Linné) of southeastern Massachusetts.*

While examining the sands of Horse Neck Beach, opposite Westport Point, Mass., on July 25th, 1893, I had my attention called to a large winged ant, with a reddish brown head and prothorax and black abdomen, which started to run away from a shell on which I had trodden. I stepped back a pace, when the ant, perceiving me, began to approach. Upon this movement I continued to retreat in order to get out of her way, but finding that the creature still pursued me, I was led to see how far

*I am indebted to Mr. Samuel Henshaw, of the Museum of Comparative Zoology, for reference to McCook's account of this ant in the Trans. Amer. Ent. Soc., Vol. VI., p. 253, and for naming the form here referred to.

the ant would continue the pursuit. Between the water's edge and the dry sand of the upper beach was a strip of wet sand some fifty feet wide and gently sloping. Over this area the ant followed me with strange persistence, both with and against the strong southwest wind then blowing. Not only would she follow me up on successively drier and firmer sand to the edge of dry sand, but back again to the water's edge, so that once she was overtaken by the swash of a small surf. The ant followed readily at a distance of three feet without regard to the direction of the wind, but, at a distance of six or more feet, entirely lost the trail. This circumstance, with the additional one that when I walked in a circle she would leave my footsteps and take a direct path towards me, shows that she was guided by sight rather than by the sense of smell.

When allowed to come up to me, the ant crawled under the shadow of my shoe and rested on the sand, and once crawled over the uppers, but returned to the space forward of the heel. When led to the dry sand she would cease to follow, and would begin to care for her chitin. In the course of the few minutes I gave to watching her, the ant followed me upwards of two hundred feet on the wet sand of the beach.

The difference in the behavior of this ant on the wet and dry sand seems to afford a clue to its mental processes. It seems to me probable that the ant had a sense of peril in its position on the wet sand, which was liable to be overrun by the sea, and that she turned toward me as she would have to a tree, or other high object, as a means of escape.

A more striking instance of intelligence in the same species of ants fell under my observation upon the island of Martha's Vineyard. These ants here, as elsewhere, build hills from one to three or more feet in height. The singular activity of the creatures, when disturbed, often led me to offer slight provocations to the occupants of one of these hills. On the occasion which I am about to describe, a number of workers were running back and forth over the summit of a hill, when I spat on it. At once the ants nearest the objectionable meteorite rushed towards it, and with their antennæ made an examination. These workers then ran a little distance away, picked up each a large grain of sand coated with a yellowish clayey film, and carrying it to the edge of the liquid, threw the pellet hastily in. This process, engaged in by at least a dozen ants, soon resulted in filling up the little pool. As these clayey pellets were thrown into the liquid they changed color through the absorption of the water by the clay. The absorption of the spittle by the pellets was evidently not yet complete, when all but one of the ants went about their customary walks. This solitary sentinel placed a pellet on the little heap and watched it soak up water, the pellet changing, as it did so, its yellowish color for a slaty hue. Another pellet was brought up and piled on as the others had been, but the process of absorption was now complete, and this last grain did not change color. The ant stood off at a distance of about half an inch from the grain he had deposited, intently watching the effect of his labors. When after a few seconds it was to be observed that the last grain was not affected by moisture, this ant turned abruptly away and joined his fellows, and no more attention was given to the object which had caused them so much concern.

The obvious effect of this application of clayey pellets was to prevent the moisture from penetrating through the roof of the ant hill into the cavities beneath. This was a clear case of stopping a leak, and that these ants know the value of sandy clay as an absorbent seems further illustrated by the frequency with which these clay-coated grains of sand are distributed about their hills. After rains, the ants may be seen bringing these objects up out of the peripheral holes of a hill and placing them on the dome to dry. It would be interesting to note whether or not dry pellets are taken below to serve as sponges in drying their underground rooms.

PROBLEMS OF ZOOLOGY.*

Ladies and Gentlemen:—Let me assure you that I am not unmindful of the favor shown in electing me to open this International Congress of Zoölogists.

Thirty years have nearly passed since I had the pleasure—as a then resident of this bustling city of Chicago—of listening to a series of lectures on zoölogy by Louis Agassiz, and as I recall the popular interest and enthusiasm which the great master inspired, and the singular activity and devotion of Kennicott, Stimpson and others of Chicago's earlier zoölogists, I am led to hope for a renewal of that early spirit and enthusiasm as a result of your meeting here.

Zoölogy, but a few years back, dealt chiefly with the habits, structure and classification of animals, and was weighted with two prevalent fallacies which theology had so generally impressed on the human mind. These were: the Biblical idea of the creation of organisms as they now exist and their consequent fixity and the homoistic notion that man was, in physical as well as psychical endowment, apart from, and not a part of, the rest of the animal world. Released from the oppressive incubus of these long-cherished fetiches, zoology has, during the past quarter of a century, bounded into the front rank of the sciences, with so many of which she is so intimately bound.

Inspired and guided by the search-light of Evolution, which reveals and makes intelligent so much that was hidden or unmeaning before, zoölogy must lead her sister sciences in all study of the genesis of life upon our planet, whether in past or present time. With the induction of the unity of all psychic phenomena and the conviction that these are inseparable from animal organization, it is her mission to give rational explanation of the subtlest of such phenomena and to check the vagaries which exist as to their abnormal manifestations; for even among lower animals there are senses and sense-organs not yet understood by us, while some species have developed a telepathy which, in its power and ease of demonstration, may well astonish those who have hitherto confined their investigations to man.

Deeper study of electricity, as exemplified in the animal world, may help the electrician to a better understanding of the nature of that force, the practical application of which to the affairs of civilized man has made such gigantic strides of late; while animal phosphorescence may yet illumine, when better understood, the path of the physicist in his investigations of the phenomena of light. Animal mechanics, as exhibited in flight, may hold the solution of practical aeronautics, which promises to cap the marvelous and momentous discoveries of the century; while to the inventor they are pregnant with yet untold and unthought-of suggestions.

That branch of zoölogy which concerns the interrelations and interactions of animals is not only fascinating to the philosophic student, but has a most important economic bearing, especially to those engaged in agricultural and horticultural pursuits.

But the subject which just now seems to be receiving most attention from zoölogists, is heredity, and the cognate question which has divided us into two opposing camps, as to whether or not characters and functions acquired during the lifetime of the individual are trans-

*Remarks made at the opening of the International Zoological Congress, Chicago, August 19, 1893, by Dr. C. V. Riley of Washington, D. C., as Honorary Chairman.

mitted to the offspring. The solid fabric which Darwin did so much to erect, and which is essentially based on the affirmative proposition, has been most persistently stormed, especially by a certain class of embryologists, and the question is too complicated and far-reaching to be lightly considered. It may be well to bear in mind, however, that the solution of the problem involves the psychical as well as the physical facts, and that the former cannot be revealed by scalpel or microscope. The naturalist who studies the development, and the actions of living organisms, in their relations to each other and to their environment, and who seeks to confirm his views by experimentation is, in my judgment, better qualified to draw reliable conclusions than either the histologist or the embryologist. Modern laboratory methods of zoological work, encouraged by the importance of bacteriology, have been so generally influenced by the microscope that they have pushed beyond the short-line of safe induction, and we already hear the murmurings of the reactionary wave which will carry us back toward the more comprehensive methods of the older school of naturalists whose names adorn the annals of our science. The microscope, however important in revealing the processes of growth, will yield us the secret of heredity no sooner than it will yield us the secret of life itself.

The latent potentiality contained in the germ, and the psychological directing force which modifies its later development, must always escape such methods. What we now most need to establish any sound theory of heredity is experimentation, intelligently planned and carried on through a series of years, not alone during embryonic, but during the whole development of the individual, and to include all the elements in the problem. Such experimentation on a sufficiently broad scale can hardly be undertaken by individuals, and the institutions which liberally endow and equip a chair of experimental zoölogy to this end will deserve well of mankind. The zoölogist, while skeptical of the ordinary theological and metaphysical interpretations of mind phenomena, is not disposed to dogmatize. His attitude is one of agnosticism on all questions as to the origin, nature and end of life, whether in its simpler or more complex manifestations; and he simply insists with Wordsworth that, "to the solid ground of Nature trusts the mind which builds for aye!"

The subdivisions of our science in which just now investigation is most active are those which shed light on the general subject of animal evolution, and our program shows that palæontology, embryology, kinetogenesis, bioplastology, heredity and kindred subjects will not lack for eminent exponents. It would be unwise to delay proceeding with such an interesting program by further remarks of my own, and I will at once call for the reading and discussion of the formal papers.

LETTERS TO THE EDITOR.

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

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

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

Red Birds and a Grosbeak.

A friend of mine bought a pair of young red-birds, from a lad who had taken them from the nest. At the same time he gave her a rose-breasted grosbeak, which he said he had found sitting on a bush, and "looking sick like." The grosbeak had no wounds, and no broken bones, and my friend placed it on a perch in the cage with the red-birds. It remained there twenty-four hours, refusing food and drink, drawing itself into a heap, and looking very miserable. Meantime the red-birds were vociferously hungry, but unable to take food for themselves, and my friend was obliged to feed them by taking them in her hand, and putting the food into their mouths with a little stick. The grosbeak surveyed this proceeding very intently, with an expression of scorn for human awkwardness!

As, during twenty-four hours, the grosbeak had seemed to make no improvement, my friend, taking him in her hands, gave him a minute examination, and found on the back of the neck the skin raised in a clear, tense bubble, as large as a bean, and of a yellow hue. She clipped a little hole in this bubble, using a pair of small sharp scissors. Only air exuded, no pus nor moisture; in a moment or two the rising was gone, and the skin resumed its place. She rubbed the incision with a drop of oil, restored the bird to the cage, and within ten minutes he was eating, drinking and hopping about in fine style.

He at once installed himself as foster-father to the red-birds. He hung over them with soft "feeding cells," holding the prepared food, and dropping it into their open throats. The little birds throve under his administration, and in a week were taking care of themselves.

A few months later, my friend being away from home over night, the servant who had charge of the birds, neglected to put any hard-boiled egg in the cage, putting in only bread and seeds. When the lady returned the grosbeak seemed to be alarmed and suffering, and, examining him, she found a wound on his back, some skin and a little flesh being gone. Thinking that a mouse, or rat, or cat near the cage might be the author of the trouble, she dressed the injury with carbolic salve, and hung the cage higher. All went well until she was again absent for two days, and there was the same neglect of diet. On her return she found the grosbeak in a very low condition, and this time with a large hole in the fleshy part of the breast. The servant said that "twice the red-birds had been fighting the grosbeak." The fact was evident, craving stronger food, they had helped themselves from the living body of their poor little foster-father. The care and skill lavished on him, and a cage for himself, were not sufficient to save him, and he died the next day from the effects of his injury.

J. McNair Wright.

Space Relation of Numbers.

With reference to the graphic presentation of numbers in the imagination, narrated by Mr. Martin in a recent issue of *Science*, I may add the following personal record. I daresay it will be found, as in most such cases, that what Mr. Martin imagined as peculiar to himself, exists in some form or other in nearly all minds, though I do not recollect having seen any reference to it, a fact due doubtless to the limited character of my reading on the subject.

From an early age I remember noting the fact, at least as early as my sixteenth year and I think a year or two before, the period being one in which I passed from arithmetic to algebra and geometry, that it became apparent to me that in the first hundred numbers the first ten appeared to lie on a horizontal line, the next ten arose at right angles and that the remaining numbers, from twenty up to a hundred, lay with more or less distinctness, not so much as visualized numbers as concepts of numbers independent of symbol, in an inclined line at an angle of about thirty or forty degrees with the horizon. Beyond one hundred I have no imagination on the subject. I may add that I was taught in the ordinary mental and high school arithmetic before Grube's system had made its appearance in American teaching. Precisely why these numbers should lie as they do, I was never able to see, although for many years I have been conscious of this arrangement and have wondered what its origin might be.

The letters of the alphabet arrange themselves for me in a visual way which is easily explainable. This is in three rows of eight each with Y, Z and Ampersand together below. The reason for this, I think, is that I learned to read without the preliminary of learning my letters, and after having been reading for several years, in my eighth year, my teacher made the agonizing discovery that while I was reading pretty much anything I pleased I did not know the order of my letters. I was, accordingly, set to work mastering an order which I will admit I have found most useful for every purpose except reading and writing. I learned the alphabet in this summary fashion out of a primer which had the alphabet disposed on its second page at the top of the page in the order which I have mentioned, and in all the manifold use of the alphabet for purposes of classification with which we are all familiar, but which we are apt to forget as a comparatively modern invention, the alphabet always seems to me to be in the three lines I have mentioned.

TALCOTT WILLIAMS.

COLUMBIAN CONGRESSES ON SCIENCE AND PHILOSOPHY.

AT least eight congresses were held during the week of August 21-26, and six are announced for Aug. 28-Sept. 2. The International Electrical Congress awakened much general interest, Professor Helmholz being a prominent figure. An illustrated lecture was given on the evening of Aug. 25, by Mr. Nikola Tesla, on Mechanical and Electrical Oscillators. This took place within the Exposition grounds, where about 70 per cent of the total horsepower of steam engines is used for electrical purposes. The Chamber of Delegates made their report on the special work entrusted to them.

The Congress on Psychical Science, with suggestions of spiritualism and hypnotism, also awaked some popular interest.

The Congress of Chemistry has been carefully worked up by Dr. H. W. Wiley, and 77 papers were announced. These were arranged in sections, as Analytical, Agricultural, Technological, etc.

Among the foreign chemists present, were Prof. Otto N. Witt, of Berlin; Prof. George Thoms, of Riga; Prof. H. R. Proctor, of Leeds; Prof. E. Engler, of Carlsruhe; and Prof. George Lange, of Zurich. X.

PALENQUE HIEROGLYPHICS.

IT is gratifying to learn that Dr. Valentini, after a long absence from the field of paleographic investigation, is about to return to it. There is one statement, however, in his communication to *Science*, Aug. 18, which needs correction. He says "Mr. Förstemann's theory of reading double columns is untenable." Now if he will refer to my "Study of the Manuscript Troano," printed in 1882, pp. 199-203, he will find this theory there set forth, as I think, for the first time, and, also, evidence of its correctness, which has apparently satisfied most students who are devoting attention to the Central American inscriptions and codices.

His statement that no month symbol appears on the tablets is made in face of evidence to the contrary, which seems to be conclusive.

I may add here that Dr. Brinton's acceptance (*Science*, Aug. 11) of the rendering given by me of the month name *Kayab*, necessarily forbids its derivation from *Kay* "to sing or warble." A compound of *ak* and *yab* cannot be a derivative of *Kay*. The *ak* may be obtained from the symbol on the rebus method of Aubin, which Dr. Brinton has rechristened by the name "Ikonomatic," but it is difficult to explain the symbol representing the last syllable *yab* by this method. If the name was formed as I suggested, and as admitted, (*Ak-yab*) the signification, with the month determinative added, is "the month when turtles abound."

CYRUS THOMAS.

Frederick, Md., Aug. 31.

COLOR VISION.

I AM very much surprised to see that Professor Ebbinghaus, in the last number of the *Zeitschrift fur Psychologie*, announces as new a discovery which has a critical bearing upon Hering's theory of color-vision,—the fact, namely, that two greys composed the one of blue and yellow and the other of red and green and made equally bright at one illumination do not continue to be equally bright at a different illumination. If two complementary colors were purely antagonistic, that is, if the color processes simply destroyed each other, as processes of assimilation and dissimilation must do, and if the resulting white was solely due to the residual white which accompanies every color and gives it its brightness, then the relative brightness of two greys composed out of different parts of the spectrum could not change with change of illumination. The fact that they do change is therefore completely subversive of the theory of Hering, or of any other theory in which the complementary color-processes are of a nature to annihilate each other. This consequence of the fact, as well as the fact itself, I stated at the Congress of Psychologists at London in August, 1892, and it was printed in the abstract of my paper which was distributed at the time and also in the Proceedings of the Congress.

Professor Ebbinghaus's discovery is apparently independent of mine, for he supposes that the phenomenon cannot be exhibited upon the color-wheel. This is not the case; with fittingly chosen papers (that is, with a red and green which need no addition of blue or yellow to make a pure grey, and with a corresponding blue and yellow) it is perfectly evident upon the color-wheel. The same paper circles which I used to demonstrate it in Professor König's laboratory, in Berlin, are, at the request of Professor Jastrow now on exhibition at the World's Fair at Chicago. While Professor Ebbinghaus's discovery of the fact is therefore doubtless independent of mine, I allow myself to point out that mine is prior to his in point of time.

CHRISTINE LADD FRANKLIN.

MYOLOGY OF THE CAT; OR THE M. FLEXOR ACCESSORIUS OF THE HUMAN AND FELINE FOOT.

THE supposed new muscle in the cat's foot (*Science*, Aug. 18, 1893, p. 97,) is, so far as Mr. Thompson's description allows of identification, probably no other than the

Accessoire du grand flechisseur (Bich.) of the Cat,
Accessoire du perodactylus (Str.-Dur.) of the Cat,
Caput plantare flexoris digitorum (Caro quadrata Sylvii) of Man,

or the M. flexor accessorius of human and feline anatomy

The flexor accessorius muscle in man originates by means of a muscular (internal and larger) head from the inner border of the calcaneum, which may be entirely absent, and by a tendinous slip which comes from the outer face of the Os calcis, just in front of the external tubercle, and from the long plantar ligament. As it has two quite constant sources of origin, so it has two insertions, one of which, however, is not constant. The usual insertion is that into the external border and upper surface of the M. flexor longus digitorum pedis, just where it divides into the four branches for the toes. (Most of the fibres of this tendon pass to the third and fourth toes, some of the fibres go to the second toe, while few, if any, are sent to the fifth.)

But occasionally this muscle inserts entirely into the tendon of the M. flexor longus hallucis. The significance of this condition will be apparent when we examine the arrangement of the parts in the cat. But first let us take a glance at anthropoid anatomy. Among the apes the flexor accessorius is wanting. The flexor longus hallucis, instead of the flexor longus digitorum pedis, supplies the perforating tendons for the third and fourth toes, and in Hylobates, for even the second phalanx as well. In this way it helps out the latter muscle, which supplies, in these cases, only the second and the fifth phalanges, or only the fifth phalanx, while the hallux receives usually only a slender tendon, which, according to Bischoff, is entirely absent in the orang. This muscle (fl. accessorius) seems to be a portion of the primitive M. flexor fibularis, which has given rise to the two muscles, flexor long. hallucis and flexor long. digit. pedis. The accessory portion is not split off in the apes,—it is, in the case of man as well as in the cat, and here its point of origin has grown distad until all connection with the leg has been lost, except in those infrequent cases where it still passes up over the median face of the calcaneum into the region of the leg. In both man and the cat it strengthens the action of the two combined flexors of the digits, and by its lateral pull gives a different direction to their action. Innervation through N. plantaris lateralis (external plantar).

In Felis the accessorius is both less strongly developed and more transverse to the foot axis, in its course, than in man, and it is frequently entirely fibrous without any muscular tissue, *i. e.*, reduced to a mere ligament. When well developed it forms a small flattened plate which arises from the inferior portion of the external faces of the calcaneum and cuboid, from whence it passes inwards and downwards, posterior to the fused tendons of the Mm. flexor longus digitorum pedis and flexor longus hallucis to near where they fuse, at which place it inserts into the internal border of the tendon of the flexor long. hallucis. Usually the insertion is not confined to the internal border of this tenden but involves a greater portion of the broad tendinous plate formed by the fusion of the tendons of the two digital flexors above named. The fusion of their tendons practically makes a single muscle out of these two toe flexors. This is equally true of man. This fact helps to explain the varying insertion in man from a mechanical standpoint.

Briefly summarized.—The accessorius in man usually presents a muscular body, which, however, may be absent, while in the cat it is often absent and normally of much feebler development than in man. In the human subject the insertion is usually into the external border of the flexor longus digitorum pedis, though it may be entirely into that of the flexor longus hallucis, while in the cat the usual and best developed insertion is into the tendon of the latter muscle.

In conclusion, the muscle is an old friend, both in cat and man. HOWARD AYRES.

The Lake Laboratory, Milwaukee, Aug. 24, 1893.

DAMAGE TO COTTON BY LIGHTNING.

ON July 26, 1893, during a thunder storm there was one heavy report noticed in the direction of some cotton plats. The bolt seemed to have "struck" near the plats. The next day a spot in the midst of the plats was found where the most succulent parts of the plants were wilting. Examination showed no visible injury as the cause. There had previously been no sign of blight or disease, whatever, which could have caused the cotton to droop.

The rows run north and south, and five were affected; three for nearly a rod, the one on the east half that distance, and the fifth on the west very little, only two or three of the tallest plants being affected.

By common consent of those who saw the cotton it was agreed to be the work of the thunderbolt, and was so noted. No place where violence was done could be found in the soil.

Frequent observation during the first month has failed to see any increase in the blasted circle. In the whole space twenty-five or thirty plants have died, while others have low branches thriving and bearing fruit and flowers. If a fungus has done it some plants have *resisted* in part and succumbed in part, or the fungus has but partially done its work.

My notion of a discharge from an electrified cloud is that the interchange between it and the earth charged with the opposite pole is carried on by every leaf and point not repellant to the fluid; that if any plant from a tender annual up get more of the electric fluid than it can safely carry it will be injured according to the strength of the overcharge, even to total destruction, involving appearance of great physical violence, if the charge is heavy; and that the discharges take the line of least resistance, according to the common explanation of the zigzag course of lightning.

If this notion of lightning discharges is correct, is not the supposition that this particular occurrence is due to lightning based on tenable ground? Might not a bolt of lightning descend obliquely from one side or other, and when near the earth be deflected upward, but yet come near enough to the ground to destroy the life in the tallest of those plants while not destroying the low laterals of the shorter plants? Or may not this discharge be considered as having entered the earth through those plants with the observed effect to destroy so many of the first conductors—the tallest ones—and nearly all of the others nearest at hand; while of those furthest out only the highest points were harmed? FRANK E. EMERY.

Raleigh, N. C., Aug. 26.

ON SOME NESTING HABITS OF THE AMERICAN GOLDFINCH.

IT is probably a truth that every ornithologist has some bird which is his particular care to study; and being myself no exception to the rule, I thought perhaps a few notes on the nesting habits of the American Goldfinch, observed while collecting a large series of their nests and eggs, might be acceptable to the readers of *Science*.

Although found in southern Michigan throughout the winter in scattered flocks, it delays nesting until the latter part of July or the first of August. On studying the nests of the Goldfinch all will be found to be at least slightly different, yet there seem to be two distinct patterns in their architecture. The first and most common form is massively built and forms a thick cushioned receptacle for the eggs. An example of this class, which I have before me, has walls about an inch thick, while the distance to the bottom of the crotch in which it is situated is about three inches. The whole mass is composed of very fine fibres and thistle-down; and as this pattern of nest is usually situated where the twigs are thickest, it may easily be seen what a useful purpose it serves in deadening the force of a sudden blow or jar, which might otherwise result disastrously to the eggs. A two-storied nest of this kind I found in a blackberry bush on August 3. The lower nest containing a Cow-bunting's egg, over which was built another nest containing six eggs of the Goldfinch.

In the nest of the second form the walls are much thinner, and the general form and structure much resemble a Vireo's nest. These beautiful frail structures, however, are much better adapted to their position on the ends of branches than the thick nests would be if placed in that position.

The eggs are from three to six in mumber, most commonly five, blue, unspotted, save in the instance of two sets evidently belonging to the same pair of birds, which I found, one set in 1890, the other in '91, in the same tree. The eggs were finely spotted with reddish brown forming a wreath around the larger end. I have never heretofore seen an instance of spotted eggs of the Goldfinch noted in ornithological publications, and I believe their occurrence is somewhat uncommon. PAUL VAN RIPER.

PHYSICAL CHEMISTRY AT THE COLUMBIAN CONGRESS.

THE recent doctrines of chemical energy are pushing towards the front. The opening paper on physical chemistry was presented to the Congress by the writer of this report, who called attention to the valuable results arising from "the cross-fertilization of the sciences." The physical properties of substances have long been studied, under the name of chemical physics; such data are indispensable in chemical analysis, technology, etc. But, with transposition of the terms, we find more attention given to the properties of energy itself, and to the conditions of equilibrium, and of rapid or slow change. These generalizations promise to be most fruitful of results, and deserving of general recognition in our universities.

The second paper, "on chemical energy," was contributed by Professor Ostwald, of Leipsic, who is indefatigable, both in research and in expounding the progress of science. The two factors, capacity and intensity, are discussed and illustrated in this paper, with great perspicuity. Capacity is proportional to the mass; for two tons of coal, by combustion, will yield twice as much heat as one ton. To estimate the intensity, on the other hand, we may remember that heat conduction always implies some difference in heat intensity; so, a chemical transformation implies greater intensity of chemical energy in the reacting bodies than in the reaction products, under comparable conditions. A "chemometer" anologous to thermometer, though not yet complete, is not wholly unknown. Emphasis is given to the theorem, "two potentials which individually are equal to a third are equal to each other," with important deductions therefrom; and catalytic bodies are discussed in relation to the acceleration of chemical change.

A third paper, by Prof. J. E. Trevor, of Ithaca, states the fundamental equations of equilibrium, for three leading cases, and presents some extended mathematical deductions.

Three other communications, assigned to this section, are of more varied character. Prof. E. W. Morley stated by request some of his results in determining the atomic weight of oxygen, with remarkably close agreement, at about 15.88; but the work is still in progress.

Professor Lunge, of Zurich (whose genial presence added much to the interest of the Congress) described apparatus for promoting the interaction of liquids and gases. Perforated earthenware plates, of special form, are so placed as to promote contact of the reacting substances, —as in sulphuric acid manufacture.

Prof. T. H. Norton communicated a paper from Professor Orndorff, illustrating by models the stereochemistry of paraldehyde and metaldehyde $(C_2H_4)_3$. The three methyl groups are assumed in one case to be all on one side of the plane of the carbon-oxygen ring; and in the other case to be distributed on both sides.

ROBERT B. WARDER.

HOWARD UNIVERSITY, WASHINGTON D. C.

GREAT HORNED OWLS IN CONFINEMENT.

WHILE collecting in some dense pine woods early in April, 1886, I saw a great horned owl about every day which flew from a nest in a pine tree. This tree was the tallest of its kind in the vicinity, and the nest was at least seventy-five feet from the ground. Thinking I might secure its eggs or young, I climbed the tree and found, much to my disgust, that the bird used the nest only as a roosting place.

By patient watching and hunting I discovered its nest April 19, in a large chestnut tree. It was composed of coarse sticks and was lined with feathers and down from the parent bird, and had the appearance of having been a deserted hawk's nest.

Here I found two young birds which were covered with down and were about half grown. Their tail and wing feathers were just starting out. They tried to defend themselves like an adult bird by keeping up a continual hissing and blowing sound, and at the same time snapping their bills and opening and closing their eyes. I noticed that they occasionally made a low, murmuring sound, and also a louder and harsher note, which they make now when hungry.

In the nest with them were two half-eaten fish, *Catostomus communis*, and the hinder portion of two brown rats. When in confinement, a week or two later, they ate voraciously, and one day I offered one a dead mourning dove. It seized it head first, and in a very few minutes succeeded in swallowing it entire, except the tips of its tail feathers, which protruded from its mouth. I expected then it would fall a victim to its gluttony, but within a very short time the tail feathers had disappeared, and it remained very quiet for two or three hours, after that it showed no discomfort whatever from its meal.

April 27 they could walk quite well, and about June 15 the feathers started out on the head of the smaller bird, which I believe to be a male, although it was by far the larger when taken from the nest.

The feathers on the larger, or female bird, did not appear until July 4, and at this date the wing and the tail feathers on both were full grown. After this time they consumed but a small portion of the food they formerly did, although they occasionally ate voraciously. They seem to prefer rats, mice, birds and are quite partial to beef.

About the middle of October the larger, and what I believe to be the female bird, began to hoot, but not very loud. This is performed by the bird standing at its full height, with its ear-tufts (which were fully developed October 1) erect, but slightly slanting backward, and swelling out its throat it gives utterance to the notes, "waugh ho ho ho ho."

They recognize all strangers, and appear afraid of dogs, horses and cows, but always show fight and act on the defensive. Their way of showing fight is to lower their head and tail, and spread their wings to nearly their full extent, but arching them so as to protect their body, and at the same time utter a peculiar blowing or hissing sound, accompanied with a snapping of their bills.

They have been confined in a large cage for over seven years, and during this time have showed no inclination to breed, and when not disturbed have made no attempts to escape, but sit quietly on their perches through the day. Just after dark they move about considerably.

Their "hootings" seem to be confined to no especial season of the year, but can be heard almost any night, and are quite noisy moonlight nights.

As they grow older they consume less food, and are not fed oftener than every other day. They are strong and vigorous, and, as a proof of their muscular powers, I once saw the female lift a dead turkey, which weighed no less than eight pounds, bodily, from the ground.

Their sense of hearing is especially good; the least noise always attracts their attention. As for their eyesight, in broad daylight no birds could be better, as I have frequently noticed them looking at birds, which were flying over, at very great heights, on very clear and bright days.

They have never made any attempts to breed whatever, nor has either one shown any affection for the other, although they seem to be on the best of terms, except when eating they occasionally have a scrimmage over a piece of meat. WILLARD E. TREAT.

East Hartford, Conn.

BOOK-REVIEWS.

An Introduction to the Study of the Dependent, Defective and Delinquent Classes. By CHARLES RICHMOND HENDERSON. Boston: D. C. Health & Co. 12°, 272 p. $1.50.

THE author of this book has been for more than twenty years a student of the classes of which it treats, and has been connected with many agencies for their improvement and reformation. He has not only been a close observer of those classes and of the methods that society has adopted for dealing with them, but is also widely read in the literature of the subject; and his book shows that he has read with discriminating judgment and to good purpose. Mr. Henderson is assistant professor of social science in the University of Chicago, and evidently had his pupils in mind in preparing this book; for it is not designed for those professionally engaged with the dependent and criminal classes, but rather for the educated citizen, who only wants a general knowledge of the subject. The book is divided into three parts, corresponding to the three classes of which it treats; and these parts are again divided and sub-divided into chapters and sections; the work of division and systematization being carried, as it seems to us, to excess, since it gives the treatise too formal a character without adding to its scientific value. The author expresses himself plainly and with judicial temper, and has no hobbies, scientific or practical, to cloud his judgment.

The part of the book relating to the defective classes, such as the insane, the blind and others, is quite short, the author evidently feeling that the treatment of those classes is rather out of the range of social science. The chapters concerning pauperism, its causes and remedies are good; and though they contain nothing new or striking, they present the best views now prevalent and also the methods now employed by the leading nations in their treatment of the poor. But by much the larger portion of the volume is devoted to the criminal classes, with special chapters on the criminal type and on the causes of crime and the best methods of dealing with it. Mr. Henderson, though evidently familiar with the Italian writers and others who regard crime as similar to disease and as largely due to biological causes, does not share their views; but maintains that the source of crime is in the moral nature, and consequently that remedies and preventives must be such as will have a moral effect. At the same time he by no means overlooks the fact that criminals are of different kinds, and that in the case of some of them poverty and other unfavorable circumstances have been contributive causes of their crime. We commend the book as a convenient introduction to the subject with which it deals.

Alternating Currents of Electricity: By Gisbert Kapp, C. E., M. I. C. E., M. I. E. E., With an introduction by William Stanley, Jr. New York: W. J. Johnston Co.

ALTERNATING current work has been developed so recently that there are a large number of electrical engineers in the profession who finished their technical education before the subject had attracted much attention. Of these a goodly number have since worked up the subject, among them being some of the best-known specialists in that branch.

Others, however, have not been so fortunate. Thrown into out of the way places in the exercise of their profession, they have not had the opportunity or time to follow up the subject.

To such this little book may be recommended as an introduction to the more mathematical treatises of Fleming, Blakesley, and Crehore and Bedell.

It deals with the subject in the most elementary way, so simply that it is practically impossible for any one with the most superficial knowledge of electricity not to arise from its perusal without a knowledge of the main characteristics of an alternating current, how it differs from a continuous current, the principles of the working of alternating current apparatus, and the ability to read the more mathematical treatises comprehendingly and understandingly.

The introduction is somewhat of a disappointment, as it contains, with the exception of a pertinent warning against the fallacy of supposing that the field produced by a two-phased current is more irregular than that of a three-phased current, practically nothing but a review of the book. One feels that more might have been looked for from one who has been so long in alternating current work and has done so much for its development.

There are few things that can be criticised in the book itself. The mathematical proof of the expression for the mean current, given on page 45 might be altered for the better, as it is not usual to change the variable in an integral without changing the limits between which the integral is taken, nor to integrate an angular expression between time limits.

The explanation of magnetic leakage on page 95 may also be objected to. Lines of magnetic induction are caused by a magneto-motive force, and magneto-motive force is a vector quantity. Consequently, when two magneto-motive forces are superimposed, there is not a formation of lines of magnetic induction corresponding to each of the magneto-motive forces, but one set of lines corresponding to the resultant M. M. F.

In conclusion it may be said that, to those who are in want of a very elementary book on alterning currents, this treatise will supply what is desired.

R. A. F.

THE last number of Vol. V. of the *American Journal of Psychology*, which has just been issued, contains practical suggestions on the equipment of a psychological laboratory by Dr. E. C. Sanford. A study of Pseudo-chromesthesia, mostly among the students of Wellesley College, by Professor Mary W. Calkins, illustrated by many new diagrams and tables. A brief system of Ejective Philosophy, in seven pages, by T. P. Bailey. An attempt to explain the Hegelian Philosophy psychologically, by A. Fraser. The longest and most popular article is an account of the Neo-Christian Movement in France, by J. H. Leuba, a Frenchman by birth and education and Fellow at Clark University. The artistic sensualists, Huysmans, Beaudelaire, the school of decadents, illustrated by Kahn Réné Ghil and Mallarmé; "the literary critics and chronicles," "the tormented," like G. Duruy, Jounet, Lasserre, Bouchor, Bourget, etc., are characterized with just discrimination and knowledge. The Neo-Christian movement proper, represented by Lavisse, De Vogué and Desjardins, concludes a sketch which constitutes by far the best presentation of these remarkable literary movements that have yet appeared in English. The usual reviews follow.

EXCHANGES.

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"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | – will exchange for any works or pamphlets on American Slugs or Anatonry of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

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WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

SCIENCE

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NEW YORK, SEPTEMBER 15, 1893.

"CARBORUNDUM"; A SILICIDE OF CARBON.

BY WILLIAM R. BLAKE, NEW HAVEN, CONN., AND SHULLSBURG, WIS.

UNDER the name "carborundum," a new compound of carbon and silicon has been commercially introduced as an abrasive; a substitute for emery and corundum. It is a very hard crystalline solid, of a deep green color, and was obtained about the year 1890 by Mr. E. G. Acheson, of Chicago, while experimenting with the electric furnace with the intent of producing artificial diamonds. Under the supposition that he had obtained a compound of carbon and alumina he gave it the name "carborundum." Analysis,* however, shows the following composition:

Si	69.10
C.	30.20
Al_2O_3 and Fe_2O_3	0.49
CaO	0.15

Which may be expressed by the formula SiC; the other substances being regarded as impurities, and as imparting the color, which is found to be variable, from nearly white to a deep green and blue.

At a session of the Academy of Sciences of France, May 16, 1892, M. P. Schützenberger described the production of a new compound with the same formula.† It appears, however, that some carborundum had previously been molded into buttons and mounted in bulbs for electric lighting and exhibited by Mr. Nikola Tesla before the Institution of Electrical Engineers in London in the month of February, 1892, but its composition was not then known.

The value of this substance as an abrasive has led to its manufacture upon a large scale, and its introduction in the form of powders of different degrees of fineness, and of wheels and whetstones and polishing cloths.

The processes of manufacture are described in the memoir cited and also in another by the inventor,‡ which gives illustrations of the furnace, which consists merely of a rectangular box, about six feet long, eighteen inches wide and a foot deep, built up of fire brick, in which a mixture of sand and carbon is exposed to the electric current for eight hours. The result is a mass of crystals of small size, which is crushed, and the powder is digested with dilute sulphuric acid to remove impurities.

The crystallization has been carefully studied by Prof. B. W. Frazier, of Lehigh Univ., who finds it to be rhombohedral, and in some cases hexagonal. Both direct and inverse rhombohedra were observed and determined, viz.: 1-5, 4-5, 10-11, 1, 5-4, 4-3, 10-7, 2, 5-2, 4, 19-4, 5, 10.‖ In some crystals the direct and inverse rhombohedra of the same parameters were found on the same crystal, so as to impart to it an appearance of holohedral hexagonal symmetry.

The value for the length of the vertical axis is given as, $C = 1.2264$.

In the crystals which I have examined the tabular habit prevails, and as seen under the microscope they consist of hexagonal plates with the rhombohedral planes too small to permit of their inclination being measured.¶

The specific gravity of a bluish-green colored mass as determined by myself at 60 F. was found to be 2.946. Prof. J. W. Richards found it to be for the green crystals 3.123, and for the blue somewhat less.

The hardness, which is the most important character industrially, lies between the sapphire and the diamond, and may thus be expressed by 9½. It is claimed by the inventor that the powder on a rapidly revolving lap will cut and polish the diamond, and he believes that it may be advantageously substituted for diamond dust in diamond cutting.

It is a good conductor of heat, and is not fusible before the blow-pipe. It also resists all acids, even the fluoric, and does not burn when heated in a current of oxygen; this being one of the methods adopted to obtain it free of any graphitic carbon.

The color and lustre are remarkably brilliant, and if by any modification of the process large and solid crystals can be made, we shall have a valuable addition to our list of gems.

Considering the abundance of these two elements in nature, both silicon and carbon, and the comparatively indestructible nature of the compound formed by their union, it is surprising that we do not find this compound in nature. Its absence indicates the prevalence of conditions during the formation of the crust of the earth unlike those of the electric furnace.

* By Dr. Mulhaeuser, chemist of the Carborundum Company, in Memoir by E. G. Acheson: "Carborundum, Its History, Manufacture and Uses." Jour. Frank. Inst., Philadelphia, Pa., Sept., 1893.
† Contribution to the History of Carbo-silicious Compounds.
‡ Carborundum, etc., The Electrical Engineer, XV., p. 227, March, 1893.
‖ From a Report to the Carborundum Co., Memoir cited. Appendix, p. 19.
¶ Vide Article in Eng. Min. Jour., Sept., 1893.

LATTER-DAY TAXIDERMY.

BY VERNON L. KELLOGG, ITHACA, N. Y.

TAXIDERMY is hardly recognized as one of the fine arts, yet. Perhaps it may never be. But the truthfulness of representation, and the artistic effects of posing and grouping which "mounted" animals may exhibit, can often invest such work with an interest for those who may not be much inclined toward taxidermy for the sake of the skin-preserving. The displays of mounted birds and mammals at the World's Fair present several stages of progress in the art of taxidermy, and lead one to speculate on the outcome of it all. For scientific purposes, *sensu stricta*, the making of birdskins is probably preferable to attempting the mounting of the specimens; and so perhaps with many of the mammals. Evidently, however, if the specimen in hand can be truthfully represented so far as form and characteristic position and externals go, it may serve as a teaching object to many to whom the "made" skin, with accompanying written measurements, may be without a lesson.

But it seems as if it were possible to go even farther:

not only shall the restored animal act as a lesson in zoölogy, a reference object which may impress on the student-naturalist the peculiar characteristics of the animal species represented, but the restoration may possess the power of displaying the emotions and passions; it may be beautiful; it may, in a word, appeal to the human sense just as a figure in marble or bronze or staff may. The analogies, too, between sculpture and latter-day taxidermy, in matters of technique, are striking. The sculptor makes his model in clay, and often enough, now-a-days, is done with it.

Italian artisans are clever enough to carry on the work of reproduction even to the final touches on the marble. The man mounting an elk makes a model so complete in detail that the putting on of the skin does hardly more than add color and the effect of hair to his statue. A wooden frame, a rough wrapping of tow and twine, and over all the plastic clay giving truthful detail of form, and life, compose the model. The shapeliness of the limbs, with loose or swelling muscles, the rigid tendons, the sunken flanks, the projecting angles of the pelvic and shoulder girdles, the expressive lines of the eyes and nose and mouth, all exist in the model. Over this is drawn the skin, which fits because it does fit, and which is only a bit of realism added by the sculptor-taxidermist to his model. The traditional "stuffing" is truly a matter of tradition.

The taxidermist who is a naturalist and has thoroughly studied his subjects; who is an anatomist and is true, in his work, to structural detail; who has seen his animals walk and crouch and leap, not in cages alone, but in the forest and canon; and who perceives the look of fear or defiance, the attitude of cunning or of ferocity or of pain, and carries these expressions and poses ever in his eye, to be faithfully reproduced in his restoration, is equipped as the sculptor of animals must be equipped. And taxidermy by such a taxidermist comes near to being fine art.

Among the World's Fair displays of taxidermic work a notable one is that made by the University of Kansas, in the Kansas State Building. This building was planned with special reference to the displaying of this collection, and the arrangement adopted is an effective one. The collection comprises 109 mounted specimens of North American mammals, and contains several groups, as those of the Rocky Mountain Goats and the American Bison, of special value, from the zoölogist's point of view. But the rare excellence of the taxidermic work in this collection should attract a more general interest than that of the zoölogist alone. The work was done by Lewis L. Dyche, professor of zoölogy in the University of Kansas, and a majority of the specimens were personally obtained by him in a number of collecting expeditions. Some striking groups will repay critical study. In the fighting of two moose, the faithful adherence to anatomical detail, as shown in the contracted muscles, the carefully disposed limbs, and the skilful arrangement of the heads, is no more in evidence—in fact, at first glance is far less striking—than the artistic effect of the whole. The fury and extremity of exertion of the struggling animals is impressive. In a single magnificently-antlered elk the poise, the fine contour of the body, the speaking expression of the head and face are that of unconscious superiority. A snarling wolf has a head whose modelling is a work of genuine fine art. And the fine art of truth of detail is not neglected for the whole's effect. In the Art Galleries at the World's Fair there are many excellent pieces of animal sculpture, but a critical analysis will betray in some of them a woful ignorance of mammalian anatomy on the part of the sculptor, or a wilful distortion of it by him. For example, a reclining panther, with young, on the whole a fine piece, and singularly expressive, has the lower portions of the hind legs absurdly lengthened. Again, and often, the sculptor, to show that he really has anatomical detail in mind, has practically "skinned" his animals. A lion, in staff, at one of the entrances, and a panther, in bronze, within, are examples of this peculiarity. But in sculpture, probably, the effect is the primary intention; in taxidermy, truthful reproduction is the primary intention. Where, however, the mounted animal may not only be an object of scientific value as a truthful restoration, but may be possessed of the attributes of a work of fine art, the combination is a happy one. That such a combination is possible the writer believes some of Professor Dyche's animals prove.

NOTES AND NEWS.

"Inductive Psychology," by E. A. Kirkpatrick, is an outline of the science prepared for use in the author's classes in the State Normal School of Minnesota, and bears the imprint of Jones and Kroeger, Winona, Minn. It treats of the elements of the subject only, and some of them are so briefly dealt with that the book will hardly serve for those who study without a teacher; but for classes whose teacher is capable of expanding the hints that are plentifully scattered through the book it will be useful. It opens with a brief account of what psychology is and of the proper method of studying it, and then proceeds to treat first of the general powers of the intellect, consciousness and attention, and afterwards of the various special powers, such as perception, memory, etc. The author's expression is direct and simple, and, considering the smallness of the book, the elucidation of the various topics is remarkably clear. The views presented are, in the main, those that have stood the test of time; and we notice in particular that Mr. Kirkpatrick lays little stress on physiological methods, and apparently has little faith in their efficacy. On one point we are compelled to differ with him. He alleges in his preface that psychology has hitherto been taught deductively, and he seems to think that his own "inductive" method is something in great part new; but we have never seen a deductive psychology such as he speaks of, and we can see no essential difference between his method and that of previous writers. The best feature in the book is the numerous hints to teachers as to the best mode of studying the psychology of their pupils, a feature that makes the work specially available in the training of teachers.

—The translation of Windelband's "History of Philosophy," by Professor Tufts, of the University of Chicago, will be published about the third week of September by Messrs. Macmillan & Co. The advance sheets now ready indicate that the work will prove a valuable addition to available English records of the development of scientific conceptions of nature and human life. It will be published in one volume of about six hundred pages.

—Additional announcements of books to be published this fall by the Macmillans are: "Pain, Pleasure, and Æsthetics": An Essay Concerning the Psychology of Pain and Pleasure, with special reference to Æsthetics, by Henry Rutgers Marshall, M.A.; an annotated edition of the Adelphœ of Terence, by Prof. Sidney G. Ashmore, of Union College, Schenectady; a new edition with vocabulary and notes of Zupitza's "Old and Middle English Reader," upon the vocabulary of which Prof. MacLean, of the University of Minnesota, has been at work for some years, making it very complete and accurate; and a volume of "Chronological Outlines of American Literature," on the plan of, and uniform with, Mr. Ryland's "Outlines of English Literature."

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CORN CANE.*

BY F. L. STEWART, MURRYSVILLE, PA.

IT IS the object of this paper to show from facts recently established that about one-half of the available food products of Indian corn are now wholly lost to us,—lost because unused and hitherto unknown to exist.

If it can be proved that what is thus lost can now be readily recovered, and not only so, but that it is recoverable as a new product from this plant, giving it an entirely new value, such attainable results will clearly be seen to be of great economic importance.

This consideration is entirely aside from the fact that much waste, which might be avoided, is often incurred in the production of our ordinary corn crop. Although great strides have been made within the past twenty-five years toward better farming in this country, by the adoption of improved implements and more systematic methods, it cannot be disguised that our treatment of maize, as an agricultural plant, is yet very defective, chiefly, as it seems, because its true nature and requirements are but imperfectly understood.

The tropical luxuriance of an American corn field, in the full tide of its summer growth, is something to awaken admiration: but the indulgence of such sentiment is commonly left to the artists and poets and the few students of vegetable physiology among us who have noted carefully the marvellous mechanical structure of the plant, its wonderful vigor and the perfect symmetry of its growth.

But all this goes for nothing at the harvest, when, in point of value, the dry, skeleton stalks are brought in contrast with the rich golden corn; and therefore the steady aim in cultivation has been to repress stem growth and increase the yield of grain.

No good reason is perceived why nature should so stubbornly persist in mounting the magnificent ears, which alone we set store by, upon solid culms twelve and fourteen feet high. And so, we have come to regard the huge stalks as the embodiment of much valuable constructive energy which might otherwise have been more profitably employed. True, this theory does not pass without protest; but it is satisfactory as shifting upon nature the responsibility for a condition of things which justifies the recent criticism of a surprised visitor out west, and complacently accepts it as true, that "Indian corn growing is the only business in which a man can waste forty-five per cent of his capital and yet make a living."

Certainly our appreciation of this plant and our treatment of it would be different if we knew it better. Our acquaintance with it is not yet of that intimate kind that we have with the cereals and forage plants that migrated with man from the cradle of the human race. It is true that maize has been known to civilized man, more or less, for about 400 years. Its grain is by far our most important food staple. Its production now equals about 2,000 millions of bushels annually in this country alone, in value, about 700 millions of dollars. Our agricultural system is, in a measure, shaped by the requirements of the successful growth of this crop, and we are credited abroad with knowing all that is worth knowing about it.

It has been introduced, also, into all regions of the earth where it can profitably be grown. In its already recognized relations to the welfare of man, no acquisition from the vegetable kingdom has ever been found to equal it in value. Yet the obligation thereby implied to investigate thoroughly its nature and properties has most unreasonably been avoided by those competent to do it.

It has been taken for granted, apparently, that this plant has no uses beyond those already known. In this country, at least, its established rank among the cereals is so unique and unrivalled, and its capacity to supply all reasonable wants within what we have come to regard as its proper sphere, have seemed so complete as to awaken no desire for further investigation looking toward the discovery of any possible new uses of the plant or its growth and development under any other than the usual conditions.

Some ten years ago the writer of this shared with some others in the belief that both maize and the then newly introduced sugar millets or sorghums were entitled to a prominent place among sugar-producing plants for those regions of the temperate zones which are characterized by a sub-tropical summer climate. The experiments which seemed to justify such an opinion, however, were necessarily very incomplete, and covered a period of only about two years.

In the popular estimate of the comparative value of these plants the Cape millets or African varieties of sorghum were given the preference. This was also the view taken at the Department of Agriculture at Washington, to which, by special invitation of the Commissioner, the methods and results of some preliminary tests of mine were submitted for examination and report. It is outside of my present purpose to refer to those first experiments further than to say that they were repeated very successfully at the department by the chemist in charge and by others competent to do the work elsewhere, and the reports show that the conclusions first reached were abundantly confirmed.

In the years following experiments in sugar manufacture from sorghum began to be prosecuted under the patronage of the general government,—and of some of the State governments likewise,—and they have been continued with very variable results in different localities, but with the promise of permanent success, chiefly under the favorable climatic conditions prevailing in our southwestern States, especially Kansas and the Indian Territory.

The experiments being thus limited to sorghum alone, the value of maize in this connection was left entirely an open question. Practically, its claims were completely ignored.

What follows is simply a brief narration of work performed and of results reached in the course of an investigation begun and conducted throughout by myself in a private way to determine this question. It covers a

*An account of the results of an investigation concerning the value of Indian corn as a sugar-producing plant under new conditions of growth and development.

period of the last eight years, or from 1884 to 1892, inclusive.

The motive for undertaking it was furnished in the fact that in the previous examination of this plant I had noticed that it exhibited some remarkable peculiarities, the exact nature and causes of which were unknown, and to which no former investigation furnished any clue.

When it began, I had samples of different varieties of corn growing under different conditions as to soil and culture and planted at different times. In the course of tests made in the fall of the year 1884, the results of which were chiefly of a negative character, except as proving that the exceptional richness in sugar, which, in a few instances, had been noted before in some samples, did not attach to any particular variety of corn, and that the accumulation of sucrose or cane sugar in all sorts, both of field and sweet corn, was uniformly progressive with their growth after a certain period, and reached its supposed maximum always, as had previously been noted, just before the grain began to glaze or harden. In all sorts, likewise, the fact was confirmed that after that period had passed, vital activity in the plant almost immediately ceased, and all the soluble organized materials lodged within the cells of all parts of the structure, except the grain, rapidly ran down into lower forms successively, and in a few days totally disappeared, leaving in the stalk only a vapid watery juice, which in its turn as rapidly evaporated out. Of course, only the dead, dry stalk remained, in that condition a very type of worthlessness, except as a feeble support to bear up for a time the the ripened ear.

But it was noticed that some plants of the same age and sort as these shrivelled and dead ones, grown alongside of them in the same plot, from which, however, the immature ears had been plucked some time before, did not share in that condition. Their stems and leaves, and especially the leaves springing from the upper joints, were yet green and vigorous, and when samples of them were cut it was evident that they had not diminished in weight as compared with other plants cut before the grain had matured. Some of the juice was pressed out for examination, and to my surprise it showed qualities much superior to any previously noticed that season. These indications were more than confirmed when the sample was subjected to analysis. I give below the results of the tests to determine the relative percentages of the sugars and other solids contained in this juice, as taken from my note book at the date of this first experiment made upon maize in this condition, Sept. 10, 1884.

The variety was the common yellow Dent corn usually grown in this locality (western Pennsylvania).

	Sample Sept. 10, 1884, Specific gravity of juice, 1.071.	Sample Aug. 23, 1884. Specific gravity, 1.048.
Cane sugar,	13.84 per cent	6.70 per cent
Glucose,	1.07 " "	2.50 " "
Organic matter not sugar and salts,	2.39 " "	1.80 " "
Total solids,	17.30	11.00

I have placed alongside of this for comparison, in the second column (above), the average composition of the juice of plants of the same variety, taken at the time when the grain was yet soft and when the cane sugar percentage was usually at its highest at that stage.

The experiment was speedily repeated upon another plant in the same condition and with almost precisely the same results. An increase of sucrose was indicated exceeding by nearly 100 per cent the normal as found in plants at the period of their life when it ordinarily has reached its highest limit.

This was a remarkable result in itself, but its chief significance seemed to rest in the fact that the high percentage of sugar was in some way correlated to the condition of arrested development of the grain.

Attention was at once directed to some naturally sterile plants, those upon which no ear had formed. These were still alive, green and vigorous, and closely resembled those from which the immature ears had for some time before been removed. Experiment soon disclosed an almost complete identity between them in the chemical composition of the juice. The only logical interpretation of this, supposing the results to be constant, was that the suppression of vital activity in the ear induces functional changes in other parts of the structure, especially in the stem in which the reserve products are chiefly lodged, whereby the existence of the plant is prolonged and a new direction given to the unspent energy which would otherwise have been consumed in the final development of the seed.

Taking only the totally abortive plants, abortive as to the seed, into the account, an analogue to them seemed to exist in the sugar cane, which produces ordinarily no seed at all. The relationship of the latter to Indian corn is very close. Was it possible that the arrested development of the seed, however brought about, conditions the more active building up and storage of the soluble carbohydrates, and especially cane sugar, within the cells of the stalk which seem so highly specialized for this end in both?

If so, it was hardly credible that such a circumstance should have eluded observation heretofore. Yet to that conclusion the facts so far gathered seemed to point.

If it could be fully verified as a physiological trait, under the specified conditions, it was easily seen that it would result in an enormous gain in the productiveness of the plant in two opposite directions, two full crops instead of one, the grain almost equal in amount and, superior in nutritive value to the ordinary hard corn, and instead of an almost worthless mass of dead fibre, fully developed canes, in full life and vigor, richly charged with true cane sugar.

It thus began to be evident that a new principle in the economy of the plant, unnoticed before, was in action, controlling its activities under the changed conditions.

The suggestion that the extraordinary accumulation of sugar in the juice was apparent only, and not real, the result simply of concentration by evaporation from the stem, had to be dismissed at once, for it is well known that true evaporation can take place only from dead cells, the process involving the destruction of their organized contents and not their accumulation, and is followed by immediate loss of weight.

Enough had now been learned certainly to stimulate to further research, but not enough to establish the absolute constancy of the new results reached under variously modified influences, all of which could not manifest themselves during a single season of growth. But if a thorough investigation during a series of years subsequent, covering all important points, should be found to confirm fully the outcome of these first experiments, it would be regarded as decisive. Nothing less would dissipate the incredulity with which a disclosure of the facts would be received when four hundred years of accumulated experience of the plant in cultivation, in every quarter of the world, had failed to bring it out.

To the self-imposed task of doing this work, self-imposed because neither inclination nor constraint seemed to impel any one else to undertake it, much of my time has been given during the past eight years.

In brief, it may now be said that the outcome has not only abundantly confirmed the conclusions first reached, but shows that there can be no middle ground between the common estimate of the plant and that which a logical interpretion of all the facts now disclosed forces upon us.

Each successive season a fresh series of analyses and practical tests were made and put upon record, beginning with that stage of the development of the plant, when the percentage of cane sugar had previously been supposed to have reached its maximum, and extending them through the after period of juice-ripening, brought on by the timely separation of the immature grain, up to the time of frost. It was found that the saccharine strength of the juice, under the new conditions, constantly increased in a fixed ratio, and that the life of the plant was prolonged from a month to two months beyond the natural period.

(To be continued.)

THE ASTRONOMICAL EXHIBITS AT THE WORLD'S FAIR.

The Astronomical Exhibits at the World's Fair at Chicago represent fairly well the present state of the science of astronomy. But they are scattered about in the various buildings so as to make it difficult even to find them all, to say nothing of systematic study and comparison of them one with another. In a general way, the most important astronomical displays are to be found among the educational exhibits, which are located in the west and south galleries of the Manufactures and Liberal Arts Building. In the exhibit of Harvard University, in the south gallery, is a splendid collection of astronomical photographs made by the Harvard College Observatory. Especially interesting are several photographs of stellar spectra and of nebulæ and clusters. One photograph of a portion of the moon's disk represents an enlargement of over one thousand diameters. Nowhere else can be found a better illustration of the great usefulness of photography in astronomy. The collections of Draper and Langley are to be found in the exhibits of the University of the City of New York and of the Western University of Pennsylvania. The four-inch almacantar, which is the first one constructed and used by Dr. Chandler, is in the exhibit of De Pauw University. The exhibit of Johns Hopkins University contains a fine collection of diffraction gratings and photographs of spectra by Professor Rowland. In the German Educational Exhibit, in the west gallery, are specimens of the famous Jena optical glass, the original spectroscope of Kirchhoff, and some fine mathematical models by Brill. Here is also shown the magnetic apparatus of Gauss and Weber. Near by, in the English Exhibit, is the display of the Royal Astronomical Society, containing a large number of astronomical photographs by Roberts, Gill and Abney, and still others from the Royal Observatory at Greenwich. Boeddicker's drawings of the Milky-way and Dr. Common's five-foot glass speculum are in the English exhibit. The latter is unsilvered and has evidently been placed with greater care to secure safety than visibility. In the Swiss Exhibit, in the main aisle of the Manufactures Building, is a display of instruments by La Société Genevoise.

The exhibits of the American makers of astronomical instruments are in the north gallery of the Manufactures Building, just over the main aisle. Warner and Swasey show a fine twelve-inch equatorial telescope, with smaller instruments, and also the mounting of the great forty-inch Yerkes telescope, which is set up at the north end of the main aisle. The appearance of the great telescope gives an impression of symmetry and strength. The lens for it is being made by Alvan Clark & Sons, of Cambridgeport, Mass. They report satisfactory progress, but say that it will not be finished for a year or more. The Clarks, by the way, make no exhibit at Chicago. J. A. Brashear, of Allegheny, Pa., exhibits the stellar spectroscope for the Yerkes telescope. He also shows an eighteen-inch and a fifteen-inch objective, gratings, specula, etc. G. N. Saegmuller, of Washington, exhibits a variety of instruments of precision, among which are a nine-inch equatorial telescope and a four-inch steel meridian circle. The exhibit of the Gundlach Optical Company also deserves mention. The American instrument-makers, as a whole, make a most creditable showing. The displays of the foreign instrument-makers are, many of them, located in the Electricity Building. Schott und Genossen, of Jena, show a large number of specimens of optical glass, and among them are two twenty-three-inch discs of the celebrated Jena glass. Merz, of Munich, shows two equatorial telescopes and several telescopic objectives, the largest of which is ten inches in diameter. The Repsolds, of Hamburg, seem not to be represented—a fact much to be regretted.

Dr. Gill's interesting stellar photographs are in the Cape Colony Exhibit in the Agricultural Building, and the Lick Observatory display is in the educational department of the California State Building, and is strangely enough mixed up with the kindergarten exhibit there.

The U. S. Naval Observatory Exhibit is a small observatory located northeast of the Government Plaza, and is in charge of Lieut. A. G. Winterhalter, U. S. N. There are a small equatorial telescope, photoheliograph and many smaller instruments. The Weather Bureau Exhibit, a short distance to the west, is well worth a visit. The exhibit of Coast Survey apparatus, in the U. S. Government Building, is full of interest, from the geodetic standpoint.

SCIENCE TEACHING IN SECONDARY AND PRIMARY SCHOOLS.

DR. GEO. G. GROFF, LEWISBURG, PA.

It has long been a dream of scientists that the time would come when the elements of natural history and of the physical sciences would be taught in secondary and primary schools. To thinking people it does not seem necessary to argue that every boy should be instructed in the elements of chemistry, natural philosophy, botany, geology, zoölogy and physiology. To persons not teachers, it would seem no difficult matter to find a place in the school curriculum for the elements of the above sciences. But it remains true that they are not taught, or taught to such an extent, and in such a manner, as to produce results entirely worthless.

Why is this condition of things prevalent? Why, after all that has been said and written, is there is no change for the better? The answer seems to be this: The elements of the sciences are not taught in elementary and primary schools for the reason that the teachers themselves have never been taught, and without instruction they feel that to attempt to teach these branches they would be blind leaders of the blind. More than this, the schools whose special duty it is to train teachers for primary and secondary schools, have not begun to do any real work in the line of science instruction. The sciences in these schools are so placed in the background that practically no training at all is given in them. It is then no wonder that the graduate of such a school does not feel capable of giving any instruction in even the elements of the sciences. To demonstrate the above statements the catalogues of the Pennsylvania State normal schools will be examined, and certain results tabulated. It will be seen that the teachers of *arithmetic* and *grammar* far outnumber those of science. But let the official announcements of the schools speak for themselves.

	No. Students.	Teachers Grammar.	Teachers Mathematics.	Teachers Science.	Remarks.
1st District, - -	800	6	9	1	
2nd " - -	979	2	5	2	Physiology taught by a physician.
3rd " - -	662	2	5	2	
4th " - -		1	1	1	Not yet opened.
5th " - -	360	1	2	1	
7th " - -	360		1	2	The science teachers devote but part of their time to their own dept.
8th " - -	579	2	2	1	Science teacher is also instructor in gymnasium.
9th " - -	666	2	2	1	
10th " - -	711	1	1	2	Assistant teaches history and zoology.
11th " - -	500	1	1	1	The science teacher is also teacher of ancient languages.
12th " - -	530	1	1	1	
13th " - -	526	1	1	1	Science teacher teaches grammar also.
12 schools,	6,673	20	31	16	

By above table it will be seen that for 6,673 students some sixteen science teachers are provided, but in six instances these teachers give instruction in other branches, leaving but ten teachers devoting all their time to scientific instruction. The extreme illustration is seen in the first district, where fifteen teachers instruct in mathematics and grammar to one solitary teacher in science.

If, however, we further examine the catalogues, we find that in the elementary course (which is the only course the great bulk of the students take) the sciences required are physiology and hygiene, elementary natural philosophy and botany. To teach physiology and hygiene to teachers, it might readily be supposed that a person trained in medicine would be demanded, but only *one* such trained teacher is found in the twelve schools. A fair knowledge of elementary natural philosophy is imparted, but the work in botany is abridged to so short a time that it is questionable whether the graduates are able to do much with it when they become teachers themselves.

In the scientific course, which extends over two years, chemistry, zoology and geology are taught for one term each, natural philosophy for two terms. The same criticism is applicable to the scientific work in this course as is made above for the work in botany.

If, from the strictly professional schools we now turn to the academies and colleges, which prepare a large proportion of the teachers of the state, we will find much the same condition of affairs. As a rule, the academies and seminaries can afford but a single science teacher. With the colleges it is but little better, except that largely these institutions have been able to secure two professors for the scientific branches, chemistry and physics being assigned to one, while geology and the organic sciences are given to the other. Pennsylvania has twenty-six colleges for men (part of these co-educational) and eleven for women (Last report of U. S. Commissioner of Education). Of these thirty-seven institutions, the University of Pennsylvania, Lehigh University, the University of Western Pennsylvania, Lafayette College and Bryn Mawr College are the only ones in any wise fully equipped for scientific work. In some cases there are more than two science professors in one institution, but in other cases there is but a single instructor. The writer has not, in his possession, catalogues of all the colleges, and hence cannot make a tabulated statement, as has been done for the professional schools.

The answer then is reached. Scientific instruction in the public schools is a failure because teachers are not trained to impart it. At present, mathematics and grammar are considered of far more importance than science in the training of teachers. How long this state is to continue no one can affirm. The only solution of the problem is better all-round preparation for teachers.

ELECTRICAL COOKING.

Some years ago (in December, 1890) the writer made some experiments with a view to determining the efficiency of electrical cooking, as the general opinion at that time was that any such employment of electricity would be too inefficient to be commercially practicable, and the writer had reason for believing otherwise. These experiments showed conclusively that the use of electricity for cooking was more economical and efficient than the use of coal in an ordinary cooking stove, but, as it was the intention of the writer to take out patents on several points, these results were not published at the time.

Since 1890, the fact of the efficiency and low cost of electrical cooking has been generally recognized, not only theoretically, but also in practice. But although there are now at least a dozen companies engaged in producing electrical cooking apparatus, and their productions are finding their way into hotels, dining cars, steamers, and private houses, so far as the writer knows, there have not as yet been published any tests of the relative efficiency of the new apparatus and the ordinary cooking stove. For this reason the following results may be of interest, the more especially as the results show the truly awful waste of fuel at present taking place, and the direction in which improvement both in heating and cooking must be looked for.

Details of apparatus used in making test. The cooking stove was of the ordinary type, the enclosed grate which holds the fuel being twelve inches long by six inches wide by six inches deep. Area of top of stove, seven square feet. Size of oven, 2x1.6x1.6 feet. Number of orifices on top of stove, six. Orifices eight inches in diameter. A damper is so arranged that the heat passes directly up the chimney, after passing the six orifices for culinary utensils, or may be directed around the oven, after passing two orifices only. The total radiating surface is 37,200 square centimetres, approximately, and the average all day temperature, so near as could be ascertained, nearly 100 degrees C.

The box for electrical heating was a cube whose sides were one foot in length. It was of polished tin, but no attempt was made to render it more bright than it was when bought. The box was heated inside by passing a current of electricity through a coil of iron wire wound inside the box. The watts used in heating could be found by multiplying the current passing through the coil by the difference of potential between its ends, a thermometer inserted in the box giving the corresponding temperature.

The total quantity of coal used in the stove, obtained by taking the average of several weeks, was thirty pounds per day. Taking the average value for the thermal equivalent of good coal, this would represent the production of 100,000,000 calories, and therefore the efficiency will be given by dividing the total number of calories of useful work obtained from the stove by 100,000,000.

We can divide the useful calories into three classes, which we will call the *c*, *r*, and *p* calories, the *c* calories being those actually used in cooking, the *r* calories being those used in raising the water in which the substance is cooked to a cooking temperature, and the *p* calories being those calories used in cleaning the cooking utensils, etc. In the case taken, the *c* calories amounted to approximately 30,000*.

The cooking efficiency, or the ratio of the calories used in cooking to the total watts in the coal, is therefore only .03 (three one-hundredths of one per cent).

The *r* calories amounted to 435,000. Adding them to the *c* calories, we get the total cooking efficiency to be .46 (46 one-hundredths of one per cent).

The *p* calories amounted to 2,256,000 approximately. Adding them to the *c* and *r* calories, we get the total all day ratio of the useful watts to the total calories in the coal to be 2.7 per cent.

The addition of the calories used in heating a hot-water apparatus for baths, etc., adds about 1.5 per cent to the efficiency, making the total all day efficiency of the stove above 4.2 per cent.

The writer has been informed that Professor Tyndall, in a test of the efficiency of a stove, obtained the figure of six per cent. This, however, must have been the maximum' efficiency, as, without the hot-water coils (which were probably not in the stove tested by Professor Tyndall) the all day efficiency can hardly reach three per cent.

There remain, out of the original 100,000,000 calories in the coal, about 96,000,000 to be accounted for. These evidently are lost up the chimney or are radiated out into the room. We may make a rough calculation of their relative and absolute amounts.

The total radiating surface is, as given above, 37,200 square centimetres. Taking the average difference of temperature between the stove and the room as eighty degress C., and taking the coefficient of emissivity of the blackened surface of the stove as .0004, we find for the total loss in radiation, for the day of ten hours, 64,800,000 calories. The remaining 30,000,000 calories must go up the chimney, or be left in the unconsumed coal.

We may tabulate the results thus:

1. Total amount of heat in coal, - 100,000,000 k.
2. Amount used in actual cooking, - 30,000 k.
3. Amount two plus amount used in raising water in which food is cooked to cooking temperature, - - - 465,000 k.
4. Amount used in cleansing cooking utensils, etc. (2,256,000) plus amounts 2 and 3, - - - - 2,750,000 k.
5. Amount used in heating bath, approximately, - - - - 1,500,000 k.
6. Amount used in warming room, - 64,800,000 k.
7. Amount lost up chimney, and through incomplete combustion, - 31,000,000 k.

From these figures we see that the name cooking stove is really a misnomer, for of the total amount of useful work which is got out of the stove, i. e., 69,000,000 calories, only 30,000, or about .04 per cent are utilized in cooking, the rest being spent in warming the room, and in heating water. It will be noticed that cooking stoves seem to be designed to present as much surface for radiation as possible, and that the efficiency of the stove as a water heater is only four per cent, while, with proper design, a water heater should have at least fifty to sixty per cent efficiency.

The efficiency of the electric heater is very simply calculated.

*The c calories were obtained by weighing the food before and after, and taking the loss in weight as due to evaporated water. This, of course, is not strictly accurate, but it must be a fairly close approximation.

A box, whose interior volume is eight cubic feet will cook the same amount as the stove experimented upon. The surface radiating heat will be, in this case, about 24,000 square centimetres, and, taking the emissivity at .00025, we get for the total loss, since the current will be only used six hours, as against the ten of the stove (as no appreciable time is required to warm the electrical oven, and the current may be cut off when not in use) a total of 7,000,000 calories lost by radiation per day, when there is not a heat-retaining covering, such as asbestos, and the bare tin is exposed to the air. It would be only 55,000,000 in actual practice, as one side would rest on a table.

By the use of proper insulation, the loss can be reduced to one-tenth of this, or 700,000 calories. We thus obtain the following table.

1. Amount used in actual cooking, - - 30,000 k.
2. Amount lost in radiation, - - - 700,000 k.
   Total cost at 1 cent per 100,000 calories (which is the actual selling price of the electric companies at present, or slightly above it, in some cities) 7.3 cents.

If we include the amount of heat used in heating the food up to cooking temperature, we get,

1. Amount used in actual cooking plus amount used in heating up to cooking temperature, - - - - 465,000 k.
2. Amount lost in radiation, - - 700,000 k.
   Cost at 1 cent per 100,000 calories, - 11.65 cents.

If we include the amount of heat used in heating water for cleaning kitchen utensils, water for bath, etc., we get the following:

1. Amount used for cooking plus amount used for heating to cooking temperature plus amount used for heating water for cleaning kitchen utensils, water for bath, etc., 4,250,000 k.
2. Amount lost in radiation, - - 700,000 k.
   Cost at 1 cent per 100,000 calories, - 42.5 cents.
   The cost of the thirty pounds of coal, at $6.00 per ton, is - - - 8 cents.

We see, therefore, from these figures, that, so far as actual cooking is concerned, electrical cooking is about ten per cent cheaper than cooking with an ordinary stove.

When we use the electric stove to heat the water in which the food is cooked to boiling point, we see that electric cooking is thirty-five per cent more expensive, if we take the ordinary prices ruling at present. As, however, a load due to cooking comes at a time of the day when a load is much desired by station managers, and would give a return at a time when the dynamos are practically doing nothing else, it is certain that there would be a deduction from the ordinary lighting rates, and the electric oven would compare favorably with the cooking stove under those conditions.

When, however, we come to use electricity as a means of heating water, for any purpose, we see that the electric cannot hope to compete with the ordinary method, uneconomical as the latter is. We are led, therefore, to the following, as the most economical method.

A boiler for heating water can readily be designed that shall have an efficiency of fifty per cent. This should be used for heating water, and also for heating the house, by means of the ordinary method of tubes. Means of effecting this combination will readily suggest themselves.

The electric oven should be used for cooking.

With this system we get the following table:

1. Cost of electricity for cooking as above, -	7.3 cents
2. Cost of heating water, for purposes as given above, and the same amount, in boiler of fifty per cent efficiency, with coal at same price as mentioned above, allowing for loss through radiation for day of twelve hours, - - -	1.2 cents
Total cost, - - - -	8.5 cents

It will thus be seen that there is practically no difference between electricity and the ordinary cooking stove, so far as cost is concerned, and it is almost needless to point out the advantages of the electric oven over the cooking stove.

In the first place, we have absolutely no dirt, the electrical oven being lined with porcelain enamel, which can be cleaned with the greatest ease. In the second, we have practically no heat outside the oven to heat the room in summer. Then we have absolute regulation of the temperature. If the oven is cold, and we require a temperature of, say, 100 degrees C. to cook something, the automatic regulator is set to 100, and in less than a minute the temperature has risen, and remains exactly at that temperature. Again, if it is desired to only cook for a certain time, say two hours, the cut-out is set for two hours, and at the end of that time the current is either stopped entirely, or is lowered so as to give any reduced temperature that may be desired.

In conclusion, we may say that the electric oven is bound to come, if only on the score of convenience and accuracy. If cheapness were the only consideration, we should still be burning tallow candles or gas, but people, and especially the American people, will always decide in favor of what is most convenient, so long as the difference in expense is not so great as to form a serious burden, and the above data will, it is thought, show that, used in a proper manner, the expense of electrical cooking need not be seriously taken into account.

It will be seen that of every 100 tons of coal used in a cooking stove, ninety-six tons are wasted. It is difficult of course, to get exact figures, but it is probable that the waste in the city of New York alone is not far from 1,000,000 tons per annum.

With the electric stove, though the cost does not greatly differ, yet by far the larger proportion of the expense is due to the labor, interest on plant, and canalization, so that (taking the efficiency of the boiler, engine and dynamo as ten per cent) the electrical oven, for the same amount of useful calories, uses only one-fourth as much coal as the cooking stove, and from a social-economical point of view, is much to be preferred, for the more we can live on the world's interest, which is labor, and the less we draw from the world's capital of fuel, the better. R. A. F.

MOUSE TRAPPING.

BY FRANK BOLLES, CHOCORUA, N. H.

Late in August the mice of our White Mountain woods, fields, and meadows, begin to show an increasing interest in corn, sweet apples, and other kinds of bait usually used in effecting their capture. In the early summer trapping them is slow work, but the chill of autumn seems to stir them to fresh activity in the gathering of food, and then pursuit of them becomes really interesting. This year I am taking them alive in order to learn more about their habits during the winter. Where, in previous years, I have set the deadly little "cyclone" traps, I am now setting the common woven-wire trap with a revolving wheel attached. For the ordinary white-footed, or deer mouse (*Sitomys americanus*), I have only to bait the trap with kernels of corn or a bit of sweet apple, and place it at sunset near my wood pile or under the lumber heap back of my barn, and the sound of the whirling wheel is soon heard. For the long-tailed, gray, white-footed mouse (*Sitomys americanus canadensis*), I go to pine stumps in the woods, or to the old logs on the shore of a pond far from houses, and feel confident of taking him wherever I have previously found traces of his presence.

It is also easy to capture the short-tailed, brown meadow mouse (*Arvicola pennsylvanicus*), who always seems to me as much like a diminutive bear as the white-footed mouse is like a tiny deer. His place of abode is readily detected, for he makes long runways in the grass leading to the holes in the ground through which he reaches his burrow. Sometimes I find him under a plank bridge which crosses a moist spot on the edge of the mowing land, but oftener I trap him in the long matted meadow grass where his paths lead here and there in search of food or water. As a rule I catch him in broad daylight when he is most active. *Evotmys rutilus* has a keen eye for protective colors. I find him most frequently in dark, damp woods, remote from houses, domiciled in hemlock stumps. His chestnut fur matches the color of a decaying stump so closely that he seems like an animated portion of the red wood. He does not, however, confine himself to the forest, for I have caught at least one of his family, close to my barn. Neither does he limit his range to low land, for I have secured specimens a thousand feet above his favorite swamps.

By far the most beautiful of the New England wild mice is the jumping mouse of the woods (*Zapus insignis*). For him I walk back a mile from my house through lonely pastures and birch woods to a mountain stream which comes splashing over a rocky bed in a dark ravine. It is not on the first, or even the second day, that he condescends, or dares, to enter the trap, although that dangerous engine is carefully covered and disguised with leaves, ferns and bits of growing moss, until it looks like a piece of the wild wood itself. At first he eats the kernels of corn or the pieces of apple which are placed farthest from the trap. Then, night by night, he comes nearer, until at last, having eaten all the corn and apple outside of danger limits, he ventures too far and is caught. Probably *Zapus hudsonius*, the common jumping mouse, is to be found in this vicinity, but thus far I have not secured him, although his cousin with the white-tipped tail might almost be called abundant. A seventh species, too well known in his customary resorts, is *Mus musculus*, the old world pest of the pantry.

Trapping mice in "cyclones" often results in supplying moles and shrews with food which they seem greatly to enjoy. In fact, *Sitomys* himself is only too willing to devour the tender portions of his own kindred. By using the wheel trap and taking my mice alive, I am not annoyed by the flesh-eaters.

SUBMARINE PHOTOGRAPHY.

BY JOHN HUMPHREY, LONDON, ENGLAND.

Several of the difficulties experienced in endeavors to ascertain the natural relations of objects existing at considerable depths under water have been overcome by M. Louis Boutan, in a remarkably ingenious manner, and the contrivances he adopted are described in a recent communication to the Paris Academy of Sciences.

He prefers to use a small camera in which several plates can be exposed consecutively, and encloses this in a rectangular, water-tight metal box, into the sides of which plates of glass are inserted to serve as windows. The camera can be so disposed that the lens may face all the windows in turn, if desired, and exposures are regulated from outside the metal case. To avoid any ill effects that might be caused by differences in the internal and external pressure when the apparatus is sunk in deep water, a kind of balloon filled with air is connected with it. As the pressure increases, in descending, the balloon is compressed, extra air is thus forced into the box, and the pressure on its walls equalized. A stout foot to support the apparatus and weights to sink it complete it for practical purposes.

In water near the shore, not greatly exceeding one metre in depth, the apparatus can be conveniently fixed, without the operator needing to enter the water, and, by direct sunlight, good negatives can be obtained in ten minutes. When the water is deeper the operator must descend in diving costume to fix the case securely on its stand before commencing the actual work of photography. In calm, bright weather photographs can then be obtained by direct sunlight in from thirty to fifty minutes. Colored glasses, preferably blue, must be interposed between the objective and the water, in order to obtain sharp images.

By the use of artificial light to illuminate the surroundings, however, matters are still more simplified. To this end, M. Boutan has contrived a special magnesium lamp. A cask of two hundred litres capacity is filled with oxygen gas, and on its upper end is fixed a spirit lamp, which is covered by a bell glass. A vessel containing magnesium, in powder, is connected with this lamp in such a manner that the metal can be projected across the flame by the action of a rubber ball which serves as bellows. The oxygen gas, of course, is intended to assist combustion, and the lamp, having been lighted and covered by its protecting globe, the cask simply requires weighting to sink it.

Good instantaneous negatives have thus been obtained by M. Boutan during a violent storm, when no daylight could penetrate the depths. They are lacking, as regards background, but this he attributes to imperfections in the apparatus, particularly the objective. He also found it necessary to place before the lens a diaphragm of very small aperture to secure a sufficient degree of sharpness. If a formula were calculated for an objective, the front of which might be exposed to sea water, he thinks these drawbacks might be remedied.

As it is, he has proved that photographs can be taken in a brief time under water, in calm weather, by direct sunlight, at depths up to six or seven metres; whilst, by the use of his special lamp, they can be taken, instantaneously, at any depth that can be conveniently reached by a diver, and the state of the weather is of no importance.

THE SCIENTIFIC BASIS OF COMPOSITION.

BY DR. CHARLES H. J. DOUGLAS, BOYS' HIGH SCHOOL, BROOKLYN.

THE end of literary composition is effective communication. To this end there are necessary, first, something to communicate and, second, some means of communication. The only thing to be communicated is thought. The medium of communication is language. One cannot, then, expect to understand the philosophy of literary composition without investigating both the nature and the process of handling both thought and language.

Psychologists recognize three distinct kinds of thought, viz., the concept, the judgment and the argument. The concept, the simplest form of thought, may be defined as the act of mind by which we merely become aware of something. Objectively considered, the concept is indivisible and unrelated—a kind of intellectual atom. The simple judgment, a more complex form of thought than the concept, may be defined as the act of mind by which we apprehend an agreement or disagreement between two concepts. Objectively considered, the judgment is a complex unit, resolvable into its constituent parts—a kind of intellectual molecule.

The argument, the most complex form of thought, is commonly regarded as differing essentially from both the concept and the judgment. It is, however, in the last analysis, nothing else than a complex judgment. It may be defined as the act of mind by which we apprehend an agreement or a disagreement between two concepts, by apprehending an agreement or a disagreement between each of them and a third concept.

The relation of logic to composition is peculiar and quite likely to be misapprehended. The formation of judgments upon a subject must, of course, precede the communication of thought upon that subject. But the formation of judgments upon a subject is nothing else than the study of that subject; it is not composition. That process begins with the selection of judgments already formed; and it ends, so far as the handling of thought is concerned, with the arrangement of them according to a certain recognized principle.

At this point, then, the mind begins a new process. Ceasing, for the moment, to form judgments about the subject of the communication, it begins to form judgments about those judgments in order to the process of discourse. This may be defined as the selection and the arrangement of judgments with a view to the greatest mental effect in apprehending them.

Thus, while the formation of a set of judgments about the subject of the communication, and of another set of judgments about the first set, are both processes implied by the process of composition, neither of them is included in that process. Again, the mind, in the formation of judgments about its own judgments, in order to discourse, is subject to the laws of logic no less than it is in the formation of judgments about the subject of the communication. The relation of logic to composition is, therefore, seen to be both vital and complex.

But, while the mind in the formation of judgments about its own judgments, in order to discourse, is subject to the laws of logic, yet the principles according to which the selection and the arrangement of the judgments are made, are not principles of logic, but of dialectic. This may be defined as the science of effective thought, as logic is the science of correct thought.

So important are the selection and the arrangement of judgments in the effective handling of thought, that it has sometimes been said that what the judgment is to the concept, and what the argument is to the judgment, such is method to the argument; and that, consequently, a fourth division is necessary to complete the doctrine of logic. Both the premise and the conclusion of this statement are, however, untenable.

It is evident that method does not sustain the same relation to the argument that the argument does to the judgment and that the judgment does to the concept, first, because the argument does not sustain the same relation to the judgment that the judgment does to the concept; and, second, because method is of precisely as much importance in simple discourse, where there are no arguments at all, as it is in reasoning, where there is nothing except arguments.

The importance of method, instead of arising from some relation which it is supposed to sustain to the argument, depends entirely upon the principle of the economy of the recipient's attention. By selection, the waste of his energy in the formation of irrelevant or unimportant judgments is avoided. By arrangement, the greater susceptibility of his mind at certain points in the time-series of cognitions which he makes, and to certain sequences of judgments, is taken advantage of.

The process of expression, like that of thought, is conditioned by the physical and psychical nature of man. It is not necessary here to describe the different steps of direct imitation by gesture and cry, of designation from analogy, and finally of imitative and arbitrary graphic representation, by which it is agreed that language was brought to its present high state of efficiency as an instrument for the spoken and written expression of thought.

Those principles of expression that are common to all languages, such as the principles of general grammar and those of rhetoric, have their basis in the nature of the intellectual processes. The principles of general grammar are necessarily the complement of the principles of logic; as the principles of rhetoric are necessarily the complement of the principles of dialectic. The special grammars of particular languages are more arbitrary in their origins, and occupy a position intermediate between general grammar and such purely conventional devices of expression as spelling, punctuation and variation of letter-forms.

The nature of the outline as a process-instrument antecedent to the full thought and its complete expression is not sufficiently understood, even by those who avail themselves of its aid in composition. The utility of the outline is due to the fact that by it we are able to express and contemplate major thought-relations without giving attention to minor ones.

The use of a certain number of visible symbols must be helpful in the process of connected thought; for by thus enlisting the service of the sense of sight, the mind is enabled the more easily to occupy itself with the judgments it has already formed, and accurately to determine their mutual relations. On the other hand, for the same reason, that is, because the mind through the sense of sight is fixed upon them, a great number of words organized into propositions, become a hindrance to that subtle activity of the mind by which, from a chaotic mass of unassimilated elements, organism of living thought is developed.

In order, then, to the most effective thinking about thought, as a process necessarily involved in that of composition, there is requisite a system of symbols which, enabling the mind through the eye to take firm hold of the growing thought, are yet not so numerous or complicated as to hinder their own frequent readjustment, as the subject takes form in the mind. These requirements the ordinary form of the outline, with its brackets and catchwords, effectively supplies.

The cry that composition as it is taught in the schools is a failure is heard on every side. Why are our teachers not more successful in this really fascinating subject? Is it not because they are ignorant of, or indifferent to, the scientific basis of composition, as it has been set forth in this article? Certainly a great reform is called for in the way of far less attention, relatively, given to the trick of juggling with words, and more to the nature and handling of thought. Frightful as the names "logic" and "dialectic" undoubtedly are to the common run of teachers, the subjects they represent not only are harmless in themselves, but lie at the very foundation of effective communication.

THE INTERNATIONAL CONGRESS OF ANTHROPOLOGY.

The International Congress of Anthropology convened at Chicago, Monday, August 28th, and held daily morning and evening sessions during the entire week, closing Saturday, September 2d. All the meetings were well attended, and there was more than a full supply of excellent papers on various branches of anthropologic science, which frequently elicited animated discussion.

The session on Monday was opened by the address of the President of the Congress, Dr. Daniel G. Brinton, whose subject was "The Nation as an Element in Anthropology." It was intended to show the physical, mental, and social changes which take place when man passes from a consanguine or tribal condition of government to that which is national. This transition exerts a profound influence on the physical man through new laws of marriage and relationship, and on religion, ethics, jurisprudence and art through the extension of the intellectual horizon. The goal of such changes, the speaker predicted, will not be reached in nationalism, but in internationalism, and in the supremacy of the individual, as the only proper aim of government. The remainder of the day was taken up with the exhibition of trepanned skulls from ancient Peru, by Senor M. A. Muniz, and explanations of the anthropological laboratories of the Department of Ethnology at the Columbian Exposition, by Drs. Franz Boas, Joseph Jastrow, H. H. Donaldson and G. M. West. The latter offered a paper of great merit on the anthropometry of North American school children, and Dr. Boas one on the physical anthropology of North America, the result of very extended measurements.

Tuesday was devoted to Archæology, principally American. Mr. H. C. Mercer, however, exhibited an artificially flaked stone from the San Isidro gravels, near Madrid, Spain, exhumed by himself, and explained its probable palæolithic character. Professor G. H. Perkins read a resumé of archæological investigations in the Champlain Valley, and Professor Otis T. Mason described in a most interesting manner the mechanical resources invented and developed by the aboriginal toilers of the American continent. The anthropological work at the University of Michigan was sketched by Mr. Harlan J. Smith; Senor Emilio Montes entered a plea for the great antiquity of the civilization of Peru; and Dr. Carl Lumholtz, just back from his explorations among the cave-dwellers in the Sierra Madre of Chihuahua, described their condition and exhibited specimens of their industries. The paper which attracted most attention, however, was that of Mrs. Zelia Nuttall on the Mexican calendar system, in which she presented a highly ingenious theory for the solution of this obscure and famous problem, supporting it with lengthy computations and the opinion of competent astronomers. The afternoon was spent in discussing the collection of games in the anthropological building by Dr. Stewart Culin, Captain J. G. Bourke and Mr. Frank Cushing.

The session on Wednesday was devoted to ethnology. It was opened by a paper by the President, Dr. Daniel G. Brinton, on the alleged evidences of ancient contact between America and other continents, in which he categorically denied that any language, art, religion, myth, institution, symbol, or physical peculiarity of the American aborigines could be traced to a foreign source. Miss Alice C. Fletcher and Prof. J. C. Fillmore presented a joint study of native songs and music of great interest. Mr. Walter Hough exhibited and described bark cloth from various primitive tribes; Mr. G. A. Dorsey related a peculiar observance among the Quichua Indians of Peru; Mrs. French-Sheldon spoke of some curious customs noticed by her among the natives of East Africa; and the Rev. S. D. Peet presented a memoir on secret societies among the wild tribes. The afternoon was spent in discussing the anthropological collections in the U. S. Government Building, Professor O. T. Mason referring to an industrial exhibit based on linguistic stocks; Mr. W. H. Holmes offering a critical study of the development of flaked-stone implements; Mr. Frank Cushing giving the particulars of a curious Zuni dramatic ceremonial; and Dr. Cyrus Alder reviewing museum collections made to illustrate religious history and ceremonies.

Thursday morning was assigned to folk-lore, and papers were presented by Mr. W. W. Newell on ritual regarded as a dramatization of myth; by Dr. Franz Boas on the ritual of the Kwakiutl Indians; by Mr. J. Walter Fewkes on Tusayan ceremonial dramatization; and by Mr. George Kunz on the folk-lore of precious stones. The afternoon was devoted to the collections of American archæology in the anthropological building under the care of Professor F. W. Putnam, Chief of the Department, who delivered the opening address on the subject. He was followed by Mr. Frank Cushing on the "cliff-dwellers"; by Mrs. Zelia Nuttall on Mexican archæology; by Mr. G. A. Dorsey on South American archæology; and by Mr. E. Volk on cache-finds from ancient village sites in New Jersey.

"Religions" was the subject taken up on Friday morning. Dr. Morris Jastrow, Jr., began with an explanation of the method and scope of their historical study; Mrs. Sarah Y. Stevenson gave an interesting sketch of an ancient Egyptian rite illustrating a phase of primitive thought; Mrs. Matilda C. Stevenson contributed a chapter in Zuni mythology obtained by personal study on the spot; and Mr. F. Parry read a theory relating to certain elements of religious symbolism. The afternoon was given to discussion of various points in North American ethnology by Professor O. T. Mason and to the ethnology of Paraguay by Dr. Emil Hassler.

The last day, Saturday, was set apart for "Linguistics," and for reading papers which had been crowded out on previous days. Dr. Daniel G. Brinton gave a brief review of the present status of our knowledge of American languages with especial reference to the parts of the continent in which it is deficient. These he especially found in Mexico and central South America. Dr. Boas stated his classification of the languages of the north Pacific coast; Dr. C. Abel illustrated his theory of the affinities of the Egyptian and European languages; Mr. Richardson read on the Cameroons of South Africa; Mr. Wildman on the ethnology of the Malay peninsula; and Dr. Jahn on the ethnological collection in the German village at the Fair. The session and the week closed with a social dinner in the Midway Plaisance given by the American to the foreign delegates, presided over by Professor F. W. Putnam and Dr. D. G. Brinton, which closed the scientific proceedings in the most agreeable manner.

All of the papers mentioned above were read before the congress and discussed as far as time permitted. Besides these, a number were read by title from writers who could not be present. Among them were Mr. Horatio Hale, A. L. Lewis, Dr. A. F. Chamberlain, Dr. F. S. Krauss, M. Raoul de la Grasserie, Dr. F. Jacobsen, Senor C. De la Torre, and others.

The number of foreign delegates embraced a fair proportion of those present, and in this respect the Congress merited its title as an "international" one. Among them may be mentioned Dr. Carl Peters, the Imperial German Commissioner for East Africa, Senor Manuel M. de Peralta, Minister from Costa Rica, Dr. Carl Abel, the well-known Egyptologist, Mr. C. Staniland Wake, of London, Dr. A. Ernst, of Venezuela, etc.

It was decided to print at an early date the transactions of the Congress by subscription. They will form a volume of 500 pages, price $5.00, subscriptions for which may be sent to Dr. Franz Boas, Secretary, Department of Ethnology, Columbian Exposition, Chicago.

FREDERICK WARNE & Co. will issue immediately a "Dictionary of Quotations from Ancient and Modern English and French Sources."

LETTERS TO THE EDITOR.

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

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

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

INSECT SWARMS.

ON the evening of June 26th, last, the fire department was called to two of the highest buildings in this city, the alarms being caused by an appearance as of smoke issuing from the pinnacles of the towers. In both cases the appearance was found to be caused by clouds of insects. On the following evening I witnessed the same interesting phenomenon about the court-house tower. I knew that I was looking at a swarm of insects, yet it was difficult to realize that it was not smoke, issuing from the summit, and driven by a brisk breeze. Near the tower the swarm was narrow and dense, gradually widening and thinning to a distance of about fifty feet, where it seemed to vanish by attenuation. The extent of the swarm varied but little during my observation, but the constant changes within it exactly simulated puffs of smoke driven away by the breeze. The deception was still more complete from the fact that the insects swarmed on the leeward side. On other dates up to July 18th I saw the same display, in each instance agreeing in every detail with the above description. The insects appeared to gather just before sunset and probably remained till attracted by the lights of the city.

On a store front near-by I captured some insects which I have good reason to believe were identical with the swarmers. These are Neuropters, about one-half of an inch in length, exclusive of the antennæ, genus and species unknown. C. D. McLOUTH.

Muskegon, Mich., Sept. 2.

PROSOPOPHORA; A GENUS OF SCALE-INSECTS NEW TO THE NORTH AMERICAN FAUNA.

SOME time ago, I found at Las Cruces, N. Mex., a chenopodiaceous plant suffering severely from the attacks of scale insects (Coccidæ). On examination, it turned out that there were three species of these insects present, all new to the fauna of the United States. One is a form of *Mytilaspis albus*, Ckll., known hitherto only from Jamaica; the second is *Ceroplastes irregularis*, Ckll., the description of which, from Mexican specimens, is about to be published; and the third, to my surprise, proves to be a new species of Mr. Douglas's genus *Prosopophora.*

The genus *Prosopophora* was established in 1892 (Ent. Mo. Mag., August) for a species found on orchids in Demerara, which superficially resembled a *Lecanium*, but was distinguished by a number of peculiar characters. This year (Trans. N. Z. Inst.) Mr. Maskell has described two more species of the genus, found in Australia on *Acacia* and *Eucalyptus* respectively. Now we have a fourth from the United States,—so that within a little more than a year four species have been discovered of a remarkable genus, which had been altogether overlooked until 1892!

Mr. Maskell has kindly sent me both his Australian species, and I have the Demerara one from Mr. Newstead. Our insect is most like *P. acaciæ*, Mask., in appearance and color, but it is amply distinct in its structural characters. I propose to call it *P. rufescens*, and the following short description includes its more important characters: *Prosopophora rufescens*, n. sp. Scale waxy, about 4 to 4½ mm. long, shape and outline of *Lecanium hesperidum*, with a slight but distinct median keel, and a subdorsal row of raised points on each side. Posterior end with a small oval orifice, as in *P. acaciæ*. Surface obscurely granular hardly shining; color pale red-brown, varying to whitish. Female with very numerous waxy filaments projecting from the surface; gland-orifices minute, circular. Antennæ 8-jointed, the last joint very short, and bearing a few straight hairs, as in *P. dendrobii*. Third joint variable, sometimes rather longer than the second, sometimes decidedly shorter. Legs absent. Anal ring apparently without hairs, but with a strong chitinous projection on each side. Mouth-parts well developed.

On boiling the insects in soda, the scale was entirely dissolved, and the insects became colorless and transparent.

T. D. A. COCKERELL.

Agricultural Experiment Station, Las Cruces, New Mexico, Aug. 29, 1893.

A SMALL TRAGEDY.

IN contrast to the "snake story," given in *Science* (Jan. 20, '93), the following incident may be of interest:

Several months ago a small spotted snake was captured and placed in the "snake box;" it is thought to be a common "milk snake," and is, perhaps, twelve or fourteen inches in length. It was somewhat injured when captured; the boys say its back was broken. It is quite evident that it was hurt, from the depression or deformity at one point, and, from this portion to the extremity of the body, it had great difficulty in shedding its skin. For days and days it was, as it were, half dressed, or undressed, as we may choose to consider this condition.

A few days ago another snake was placed in the same box—what kind it was I am unable to say—but it was a small (not more than eight or ten inches, in length), agile, quite slender little thing, of a plain slate or dove color.

What was our surprise when it was discovered that the spotted snake was in process of swallowing the smaller one. It was horrible, and yet we could not refrain from observing it. In a very short time the little snake entirely disappeared, even to the tip of the tiny tail, and the spotted snake appeared to have enjoyed the meal. The boys claim that it has eaten several small toads; it is now in company with a snake considerably larger than itself. They seem disposed to be "friendly," thus far, and no doubt enjoy each other's society.

MRS. W. A. KELLERMAN.

Columbus Ohio.

THE CACKLE OF HENS.

IT IS claimed that the cackling of hens "is very liable to attract the attention of any ovivorous bird or beast to the probable presence of an egg."

It is quite probable that ovivorous birds or beasts may understand that the hen's cackle is the announcement of the presence of an egg, but the hen is wise even in her apparent imprudence. She lets it be known that an egg is somewhere, but she does not tell where. How many, many times she sends the farmer's wife or children on a hunt for eggs they fail to find. Of course, when hens are well cared for, and ample and sufficient nests are provided, they lose their cautiousness, but when they are left to take care of themselves they will "steal" their nests, as the people say; that is, they will go off in the weeds, or seek some sheltered spot, and there make a nest. When an egg is laid, in a "stolen," nest, the hen makes a quick run, quite a distance from her nest, before she makes a sound, so that her cackle would not discover her eggs to any enemy, for one gropes, as in the dark, in search of stolen nests, no matter how loud may be the cackle.

MRS. W. A. K.

Columbus, Ohio.

THROWING STICKS.

I HAVE just made a discovery that has given me great pleasure. In the Anthropological Building at the World's Columbian Exposition is a Cliff Dweller's Exhibit, exposed by the State of Colorado. Other loan exhibits are in the building from that region, and outside is an attractive realistic representation of the industrial products of the same people. In looking carefully through the Colorado State alcove I discovered two examples of the Mexican atlatl or throwing stick. The shaft is a segment of a sapling of hazel wood. At the distal end is a shallow gutter and a hook to receive the end of a spear shaft. At the proximal end or grip, in the more perfect specimen, about four inches from the extremity is a loop on either side of the stick, one for the thumb, the other for the fore-finger. The remaining three fingers would be free to manipulate the spear shaft. These loops were made by splitting a bit of raw hide, sliding it down the proper distance on the stick, forming loops less than an inch in diameter by bringing the projecting ends of the rawhide and seizing it fast to the shaft. Just below these finger loops or stirrups were a long chalcedony knife or arrow blade, the tooth of a lion and a concretion of hematite seized by a plentiful wrapping of yucca cord. If the readers of *Science* will recall the Bourke example from Lake Patzcuaro, with its long, barbed spear with shaft of cane, he may follow me further and believe that a bit of cane and a spear head of chalcedony attached to a tang or foreshaft of wood lying in the same case, and pointed out to me by Mr. C. C. Willoughby, belonged to the same outfit. This is the first instance of finding the ancient atlatl, figured in the codices and described by Mrs. Nuttall. It also connects the Cliff dwellers with the Mexican peoples.

O. T. Mason.

Sept. 3, 1893.

Water Analyses.

Fear of cholera has caused waters to pour in floods into some of the analytical laboratories of Europe, and it is more interesting than reassuring to observe the methods followed in dealing with this accumulated work.

In the laboratory of one public analyst, the writer saw a large collection of water samples, as yet unopened, from various localities.

These samples, some of which were weeks old, had been collected in a variety of vessels, principally claret and whiskey bottles, and the corks employed were often old ones.

When one considers the excessive care required for water sampling, the thought that the above lot were doubtless taken by inexperienced hands, with the aid of vessels certainly old and probably unclean, does not increase one's faith in the value of the analytical results.

Much to my surprise, I also saw in one laboratory the old writing-paper packing for connecting the retort with the condenser, a method of union long since discarded for something more reliable. It is so easy a matter to ruin a water analysis by indifferent attention to the proper setting up of the apparatus for the "albuminoid ammonia" process that modern practice discards, as inefficient, several recommendations made by Wanklyn, the originator of the method, and among them the paper packing mentioned.

In short, without wishing to be over-patriotic, my observations here lead me to the belief that Americans do not have to go abroad in order to gather information as to the most suitable methods for making an examination of potable water.

William P. Mason.

Stuttgart, Germany, Aug. 9.

The New York Shakespeare Society has begun to reprint, in its Bankside edition, the archaic texts of the seventeen plays first printed in the Heminges and Condell Folio of 1623. The first of these plays, The Tempest, will leave the press in a few days. Of these new volumes but 500 copies are printed, as before, hand numbered to correspond with the 500 sets of the prior twenty volumes, with which they are of course uniform in style, size, price, etc.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For a rare chance to get a first-class microscopical outfit write for full particulars to box 125, Sellersville, Bucks Co., Pa.

For sale or exchange.—A fine collection of Lepidoptera, native and exotic. For particulars address Addison Ellsworth, Binghamton, N. Y., care Republican.

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U. S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | - will exchange for any works or pamphlets on American Slugs or Anatonry of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

Exchange—The undersigned is desirous of obtaining correspondents interested in macro-lipidoptera, in Alaska, the far Western, Southwestern and Southern States. Will also exchange rare lepidoptera for entomological literature. Levi W. Mengel, Reading, Penn.

Wanted to exchange—Medical books, Obstetrical Transactions, London, Works of Sir J. Y. Simpson, Beck's Medical Jurisprudence. Handbook for the Physiological Laboratory, by Burnton, Foster, Klein and Sanderson, Quain's Anatomy, and about fifty others. Catalogues given. Want Geological, Botanical and Microscopical books in exchange. Dr. A. M. Edwards, 11 Washington St. Newark, N. J.

Wants.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc., etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

A YOUNG woman who has been an assistant for a literary and scientific man desires a similar position. Is an experienced and accurate stenographer and typewriter, thoroughly educated, and sufficiently familiar with literary work to write, independent of dictation. Has some knowledge of the Spanish language. Will go to any part of the United States. Address, Box 147, Ravenna, Ohio

A GRADUATE of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

WANTED.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

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SCIENCE

NEW YORK, SEPTEMBER 22, 1893.

THE AUGUST STORMS.*

BY WALTER C. KERR, NEW BRIGHTON, STATEN ISLAND.

The havoc wrought upon vegetation in the vicinity of New York city by the recent storms perhaps deserves notice, especially considering the opportunity afforded to compare the effects of two destructive gales, only four days apart. These storms though quite similar in general character differed widely in one feature, whose destructive power might escape general notice or at least be much underrated. This feature is the amount of water in the air, which largely augments the weight of the moving column and at high velocities transforms the usually harmless wind into a formidable battering ram.

Some time since Mr. William T. Davis, of New Brighton, Staten Island, mentioned that the comparative scarcity of large trees in that vicinity was probably due to high gales, and when the results of recent storms are viewed, there can be little doubt regarding this cause.

The gale of August 24 is generally credited with having uprooted or broken more trees in this locality than any on record. This destruction of vegetation was widespread. In the cities and towns the streets were blocked with fallen trees and branches while the country roads were in many places impassable. Numerous white oak and chestnut trees were uprooted that to all appearances should have offered great resistance. This storm had a comparatively low wind-velocity, and a great rainfall.

The gale of August 29th caused some damage to vegetation, though not nearly so much as that of the 24th. At sea it was one of the worst storms experienced in this latitude for years. It was characterized by a very high wind with little rain.

It may be said that the first storm destroyed the weak trees, leaving little for the second and greater one to wreck. On the other hand it may be presumed that the first storm would cause much weakening and facilitate the efforts of the greater wind that followed.

The first storm had a maximum velocity of forty-eight miles, reached by our winds about once each month without sensible damage, while the maximum velocity of the second, sixty miles, is attained less frequently than once a year and only rarely is this high rate destructive to vegetation.

The following official records from the United States Weather Bureau, N. Y., furnish accurate comparisons :

August 24, rainfall 3.81 inches from 7.52 P. M. August 23d to 8.15 A. M. August 24.

Time,	12	1	2	3	4	5	6	7	8
Wind velocity,	29	33	27	28	29	30	23	20	

Maximum velocity for one hour, thirty-seven miles at 2 A. M.

Maximum rate for one mile, forty-eight miles between 1 and 2 A. M.

Between 2 and 3 P. M. August 24, the wind averaged thirty-five miles, with a maximum rate for one hour of forty-two miles. At this time no rain fell and no damage resulted.

August 29, rainfall .28 inches from 4 A. M. to 8 A. M.

Time,	12	1	2	3	4	5	6	7	8
Wind velocity,	24	31	33	38	38	44	40	32	

Maximum velocity for five minutes, fifty-four miles at 5 A. M.

Maximum rate for one mile, sixty miles at 5 A. M.

At this station of the United States Weather Bureau a wind velocity of forty to fifty miles is attained once a month, a wind velocity of sixty miles is attained scarcely once a year, a wind velocity of seventy-two miles is the highest on record.

These figures show conclusively that, as ordinarily measured, the second storm was by far the greater; in fact, as the wind pressure is proportional to the square of the velocity, it may be seen that the effect due to wind pressure alone on August 29, should have been nearly double that of August 24.

When we, however, give value to the relative rainfalls, 3.81 inches as against .28 inches, the destructiveness of the wet gale of August 24 becomes apparent.

In a storm a tree must resist a column of air moving at a high velocity and to a large degree consume its energy. This energy is proportional to the mass and the square of the velocity. Dry air has small mass per cubic foot, yet at forty miles per hour yields a pressure of eight pounds per square foot; at fifty miles twelve pounds; at sixty miles eighteen pounds; at eighty miles thirty-two pounds; and at 100 miles fifty pounds. If we add to each cubic foot of air one-tenth of one per cent, by volume, of moisture, as, for instance, by partly filling it with rain drops, its weight will be nearly doubled (.0753 plus .0625), and in consequence the energy of the moving mass will be likewise doubled. One-half of one per cent of water added to the air increases the energy five-fold, and thus the wind at its maximum velocity of forty-eight miles on August 24, if burdened with this amount of moisture, would have an effect greater than a dry hurricane of 100 miles. When rain falls in calm but little water is contained per cubic foot of air, but with high winds the rainfall of a large area may be carried along nearly horizontally and massed where intercepted by vertical obstacles. It is therefore reasonable to presume that trees in exposed situations receive vastly more water per square foot of surface than is measured by rain gauges in the usual way.

When wet the resistance of foliage to passing wind and rain is doubtless increased, especially when there is a tendency for the leaves and branches to mat together on the windward side, while the weight of water carried by the tree may be a considerable additional burden.

It thus becomes easy to appreciate the enormous part which water plays in the destructive force of high winds on exposed trees, as well as on the more commonly noticed windfallen grain and corn.

* Paper read at a recent meeting of the Natural Science Association of Staten Island.

PETROGRAPHS AT LAKE PEND D'OREILLE, IDAHO.

BY JOHN B. LEIBERG, HOPE, IDAHO.

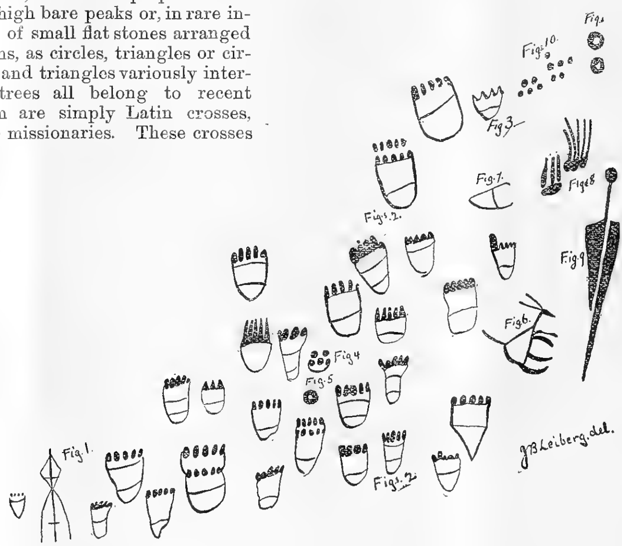
Aboriginal rock carvings or inscriptions are quite rare throughout northern Idaho. The dense forests and generally inaccessible character of the country together with a constant scarcity of natural food products furnished unsuitable conditions to sustain any considerable number of inhabitants, and those that made the country their abode appear to have been either too indolent to endure the labor required to leave any records on the rocks, or their lives did not furnish any events worth noting, in their judgment.

The records we find consist mainly of carvings on trees, or of rocks of small dimensions, raised to perpendicular positions, on the summits of high bare peaks or, in rare instances, in similar situations, of small flat stones arranged in certain geometrical designs, as circles, triangles or circles within circles, or circles and triangles variously intermixed. The carvings on trees all belong to recent years, as very many of them are simply Latin crosses, showing the influence of the missionaries. These crosses are quite common around favorite hunting or camping spots in the mountains, and appear to be made with the object in view of warding off malign influences from the camping grounds. These crosses are not to be confounded with the sign plus, so commonly made by hunters and trappers throughout the deep forests, and which merely serve to attract attention to trails, locations of traps, etc.

The raised stones, so common on high peaks, merely denote the passing of some individual, and may be quite recent or date back a long time. Sometimes white men raise these rocks. The symmetrical arrangements of rocks appear to be quite ancient. The stones composing them lie quite flat and are completely covered with slow-growing saxicoline lichens on all exposed portions. The import of these figures is unknown.

There is but one locality known to me in northern Idaho with true rock-carvings. It is located opposite the outlet of the Clark's Fork of the Columbia into Lake Pend d'Oreille, about one-quarter mile north from the shore. A rocky point of land rises abruptly to a height of 250–300 feet above the extensive marshes bordering the river at this point. The rock is a highly silicious magnesian schist, extremely hard and difficult to chisel with even the most carefully tempered modern steel tools. The schists are rather thinly bedded, have a dip of about 85°, and the wear of the lake in former ages, when its waters stood at a much higher level, has broken the strata apart and left numerous large slabs standing in an upright position. On the face of one of these tablets of rock occur the carvings as delineated in the accompanying illustration. They occupy a space eighteen feet in length, and from two feet to seven feet in height.

There are twenty-eight figures evidently representing the footprints of the bear, three of the tracks with double sets of toes, three with but four toes, and one with but three toes. Three figures which may represent tracks of the cougar. One arrow head. Three points within circles. One mountain goat. Two sets of circles composed of five and six respectively, and three large figures of unknown meaning. Besides these figures there are evidences of many light scratches, but the lines are too dim to be traced with certainty. Nearly all the figures are thickly overgrown with close-clinging rock-lichens, rendering the whole quite inconspicuous. Close and diligent search has failed to bring any further inscriptions to light in the neighborhood.



Scale one-twenty-fourth natural size.

One of the most interesting features in connection with this petrograph lies in the manner of its execution. The lines of the figures are not mere scratches, but are deep, wide grooves cut smoothly into this excessively hard rock, many of the grooves forming the representations of the bear tracks. Figs. 2 are 3.2 cm. in width and 1.2 cm. in depth, while the cutting forming fig. 3 is, in its broadest portion, 5.5 cm. wide and 2.5 cm. deep. The appearance of the grooves, the smoothness of the sides and freedom from signs of chipping give cause for the belief that they were cut into the rock by friction and not by chiseling. A piece of wood properly shaped and constantly charged with water and sharp sand could be used to cut such grooves, while the same manner of tool rotated by a bow would cut round holes such as make up fig. 10. Will some of the readers of *Science* acquainted with the methods of the aborigines in making their rock inscriptions, inform us if such tools were in use elsewhere for doing this kind of work and the meaning of this petrograph?

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

CORN CANE.*

BY F. L. STEWART, MURRYSVILLE, PA.

MUCH attention was given to the physiological affinities of maize to discover, if possible, whether in the case of any other of the solid-stemmed grasses with which it naturally ranks, a similar correlation exists between seed development and the accumulation of reserve materials in the culm, with cane sugar as the principal ultimate product.

In this connection, it became a point of especial interest to determine what the deportment of sugar cane and sorghum would be under like conditions, and accordingly the investigation was extended to them, along the same lines.

It was soon found that a comparatively new field had been entered upon and that no progress could be made without constant appeal to the microscope and approved methods of chemical analysis for the correct determination of many important questions requiring solution. Thus, some safeguard was established to prevent false analogies from being followed and false conclusions reached, such as have marked and marred the whole rationale of treatment, both of the beet and of sorghum, in the attempt to make sugar manufacture from them practicable in this country.

It was found to be the fact, uniformly, that from the time the sugar first shows itself in the cell sap, during the early growth of maize, until the grain begins to harden, it steadily increases. But what is most remarkable is that it then suddenly diminishes and disappears, leaving behind it scarce a trace of its former presence. Other allied plants, such as sorghum, up to a certain period of growth, manifest the same characteristics, but beyond that the resemblance ends. Sorghum does not reach its full saccharine strength until its seed is dead ripe. Maize, on the contrary, if its grain be allowed to pass into that condition, parts with its sugar utterly, but if the offered alternative be taken and the ear be removed promptly at the critical period, all the vital energies of the plant become at once directed to the special work of storing up highly organized food materials in the cells of the stalk. Instead of dying, off hand, as it does in the other case, the plant *lives on*, and without a break the constructive forces go on converting the simpler into the more complex reserve materials. The stalk is their storehouse, and, under the new conditions imposed, that part of the plant passes through a supplementary stage of development. Its principal function then is to accumulate sugar.

It would be out of place, in a brief sketch, to particularize the changes then occurring, further than to say that the other carbohydrates, generally, give place to sugar. There is also a sensible increase of the protein substances keeping pace with the increase of the sugar.

It is then a process of *juice ripening*; borrowing the term from an analogous process which is carried on in the maturing joints of the sugar cane. This led to a closer comparison of the latter with Indian corn when in this anomalous condition. Living ribbon cane from Louisiana, received here fully matured and in perfectly good condition, and young joints at hand growing under glass, furnished ready means of comparing them closely under all ordinary conditions of growth and development. It is very evident that the two species have then several characteristics in common which are not evident when the cane is compared with corn in what we call its natural condition. The following have especial significance, as they approach maturity.

1. In both plants the solid stalk or culm has then become simply a reservoir of materials available for plant food, and in the case of the sugar cane, made use of when active growth by the joints begins.

2. In both, the development of the organized products is progressive, *i. e.*, from the more simple to the more complex of the series, which take the soluble form and are available for transmission to any points where new organized structure is to be built up.

3. By reason of the constant accumulation of these soluble materials, chiefly, the weight of the plant and the density of the juice increase.

4. The general plan of structure and physiological properties of the stem in both are very much alike, although there are very striking differences, and they become more alike, both in structure and function, as this period advances, the separate joints of the one and the whole stalk of the other attaining their full size before the highest elaboration of their juices takes place.

5. It is a well-attested fact that ordinarily no variety of sugar cane is known to perfect its seed or, to use the language of May, "to produce anything like seed, either in India, China, the Straits of Malacca, Egypt or the South Sea Islands." By a curious analogy maize, in this secondary stage of development, is likewise incapable of producing seed, having lost, apparently, its capacity in that direction.

There are other points of resemblance which it would be interesting to note, but that to which the most importance attaches in this connection is the highly saccharine condition of the juice in both, which ranks them together more closely than their striking natural relationship otherwise would seem to justify.

The reader is referred to the table in which the average sugar percentage of both is given as based upon the most recent and reliable analysis. It will be seen, I think, that the term *corn cane* has not unreasonably been applied to a plant which in a summer's growth can thus be made to develop qualities which give it a rank second only to the tropical cane.

Also, it will be observed that the saccharine qualities of the juice, only, have been compared in the table.

But, as between the other sugar-producing plants named and Indian corn there can be no further comparison. Maize is a cereal of the highest value, and it does not lose that character in this case. The high *condition of sugar development which it can now be made to attain is not attended by the sacrifice of the grain*, and against this grain product neither the sugar cane nor the beet can show any compensating value whatever.

This fact cannot be discounted by the assumed inferi-

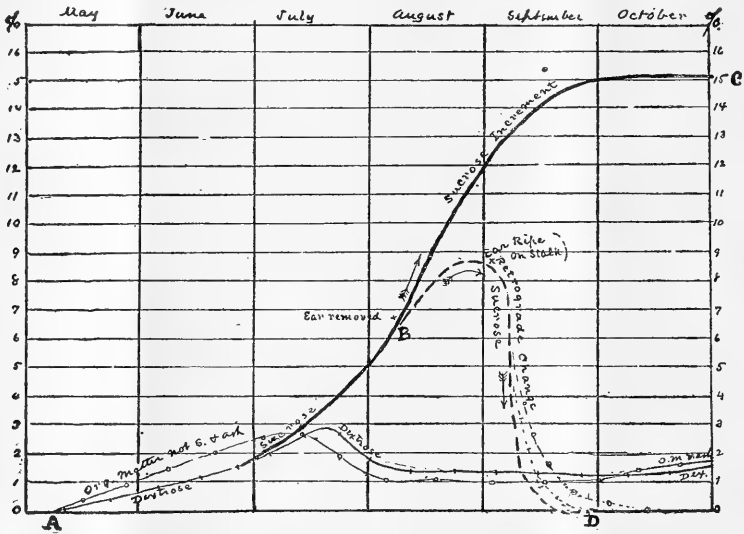
*Continued from Science, Sept. 15.

ority of the corn grain when harvested at the time at which it is necessary to arrest its development to secure the sugar crop. Fifty years ago it might have been necessary to argue that point, but within that time the corn canning and drying industry has arisen, and immense quantities of American "sugar" corn are now put upon the markets both of this country and of the old world in response to the demand for the immature grain, and within the last decade the same product from "field" corn, along with the green fodder, cured by the ensilage system, has won an established value as the best form, the most nutritive and most readily preserved without loss, in which the whole plant can be utilized for stock feeding.

This plant is capable, then, of yielding its grain in one of two widely different conditions, as widely different in fact as if they were the product of two different species. Ripeness may be affirmed of either, if by that is meant,

It does not detract from the value of our ordinary field corn in this connection that its immature grain cannot be used to the same advantage for canning or drying as that of the so-called sweet varieties. The peculiar softness and sweetness of the grain of the latter has practically nothing to do with the amount or quality of the saccharine secretion in the cells of the other parts of the plant. In fact, the plants with the richest juice are the tug-stemmed field sorts; the dwarfage of the varieties grown by the truck gardener and for canning comes from selection to produce extra early ripening, and the small size of most of these will exclude them from use where sugar manufacture is the object.

But the grain of field corn taken in this connection will serve its highest purpose for stock feeding. As will presently be shown, it has a distinct and superior value to the hard, full-ripened corn, for this purpose. Systematic experiments made within the past few years at different



DIAGRAM,
showing approximately the composition of the solids in the juice (sucrose, dextrose and organic matter not sugar and ash) during the life of the plant.—A. B. C. from planting to final ripening of juice.—A. B. D. from planting to full ripening of grain.

first, the possession by the grain of germinative power, for both will grow, and, second, a developed condition of the nutritive elements far enough advanced in the grain at either stage to fit it in the best manner for certain special uses as food.

We can have either condition of the grain at will, and our ability to secure either gives us a variety in the choice of food from this single source not approached by the products of any other plant. We have the option between two series of food products widely different, derived simply from one kind of grain taken in two different and successive stages of development.

We elect to take it at the earlier stage, when we propose to produce sugar, and our taking it then is the one condition upon which the proper juice-ripening in the cells of the stalk depends. Two crops are thus secured from the same plant, instead of one, the interval between the maturing stages of each being long enough to enable both to be properly cared for without loss.

state agricultural stations in this country, and by practical farmers, stock growers and dairymen, not only prove this conclusively, but indicate beyond question what is the best means of curing and preparing it for use as animal food. I refer to the ensilage system, in the practice of which Indian corn is almost exclusively used.

As is well known, wherever it is grown for this purpose to the most advantage the aim is to secure the most luxuriant growth, and the fullest development of the whole plant up to the time when the grain is fully formed, but still soft. Under such circumstances the ear composes a large proportion of the prepared silage, twenty-five to thirty-five per cent.

It is no part of my present purpose to discuss a point which just here demands special notice, namely, the richer quality and higher value of corn silage attainable by modifying the system so as to take advantage of the full development of the food materials within the plant, upon which, as already shown, its value in sugar production entirely depends by harvesting and pitting the ears at the usual time, and the fodder at a *later* period. As shown (in the table) there is a large increase of the substances containing nitrogen, as well as the carbohydrates under the new conditions. The special bearing which this, as well as other facts which cannot here be particularized, must have in modifying the existing system of stock feeding, either by ensilage or dry fodder, is hardly second in importance to its relations to sugar production.

Also, it should be noted in this connection that it is now found that corn fodder, cut after the last stage of the ripening of the grain has been reached, is subject to great loss of nutritive matter.‡ The destruction and disappearance of the soluble carbohydrates follow in that case as inevitably as their preservation and increase do after the removal or arrested development of the ear.

Except the trimmed stem, every other part of the plant will go to the silo, when sugar production is the object, and the resulting food products will be as much richer than ordinary ensilage in all the elements of nutrition as the larger proportion of the grain to the whole mass, and the more highly elaborated juices of the tops and leaves enter into it.

(To be continued.)

NATURE AND DISTRIBUTION OF NEW YORK INDIAN RELICS.

BY W. M. BEAUCHAMP, BALDWINSVILLE, N. Y.

WHILE Indian relics are almost unknown in some parts of New York, in others they are abundant. Forts, villages and camps are often found far away from lakes and rivers, for security from enemies was an important consideration, and when villages were established there was often regard to the fertility of the soil. As this and fuel failed, removal become necessary, but almost invariably the red man of New York placed his lodge on sandy ground. In a general way, however, the relic hunter will seek the banks of rivers and streams, especially at fords and rifts, with the best hopes of success. Hunters, fishermen, and traders have there left the finest articles.

He will soon learn that all sites are not alike, some noticeable things rarely, if ever, appearing with certain others. By close examination and comparison he may sometimes establish a sequence of sites, or discover relations between those far apart. He will be blind indeed if he does not soon see plain evidences of aboriginal travel and trade. He will learn one curious fact, that, in the larger part of the Empire State, the finest stone implements are among the oldest. With ample material for illustration before me, this paper will simply deal with the character and distribution of Indian articles in New York.

Chipped Implements.—Arrows, spears, knives, perforators, scrapers, and other articles, are quite generally found, and of all the usual kinds. A drab-colored hornstone is the most common material, but there is a great variety of others. All colors of jasper will be seen among these, with quartz, chalcedony, argillite, limestone and sandstone. White arrows are more prevalent in the eastern part than in the west, and some sites afford local and unique forms. Although hornstone is abundant in the long Helderberg range, much of the material was brought from a distance, and cores and chips occur abundantly far from the quarries. Caches of unfinished implements are frequently found, usually of one form and size, and between two and three inches long. I know of no form of arrow, knife, or spear ever described, which I have not figured from local specimens. Some are unique. Three of my arrows, above the notch, have the outline of the gable end of a house, with perfectly straight edges. Some triangular forms are almost as slender as a flint perforator.

Scrapers occur in great variety, and of as varied finish, but they are lacking in many places, as the Iroquis and some others did not use the stone scraper and drill. Neither need be looked for within earthworks and stockades. The leaf shape, combining the knife and scraper, is common. Mr. A. G. Richmond found scrapers with serrated edges at a fishing camp on the Mohawk. They were small and rare. I have found other forms from small to large sizes. Sometimes they are curious. One, of green jasper, long and nearly triangular, has a knob at the top, as though for suspension, and projecting points on either side of the broad base. Another rare form is sabre-shaped, the concave side being the scraper, and the convex, a knife. Flint perforators are often very fine, and vary from the simplest forms to those quite complex. Some are of very great interest. Flint hammers occur, and some very small flint disks a friend has called gambling flints. Rarely a hornstone celt has been slightly ground, but rude celts of sandstone are often chipped.

The flat sinkers, or quoits, are also chipped implements. They are sometimes quite large, and found near water,—sometimes in it. Usually they are between a rectangle and circle, often with notches on the four edges. I have found them, however, miles away from any fishing place, aud think they were often used in games. The smallest form I have resembling these, is polished, circular, about an inch across, and with two notches cut on opposite edges. Larger oval pebbles are found grooved for anchors. About Cayuga and Seneca Lakes, smaller grooved pebbles are abundant, about the size and form of a hen's egg.

Hammer stones, so called, are of endless forms, and of many uses. Like the preceding, they were in use quite recently. I have seen one on which a figure was inscribed with compasses. They may have one or more pits on one or both sides, or on every face on which there is room. The edges are not always hammered, and sometimes circular ones have been changed into chungke stones.

The grooved stones, used by the Iroquis about the beginning of the seventeenth century, are peculiar to their territory, thus far appearing in that of the Mohawks, Onondagas and Senecas. They are bowlders, in which appear one or more wide, straight and uniform grooves, finely striated from end to end, and are supposed to have been used in arrow making. This may possibly have been.

Occasionally finely polished pestles appear, but most of those along the Seneca River are merely long pebbles, showing use, and sometimes polished. Generally they are slightly chipped, and sometimes squared. Rarely a pit is made near one end. The Iroquis used, and still use the wooden pestle with double ends.

‡This is an invariable result, and it sufficiently reveals, I think, the source of the hitherto unaccountable loss of solids reported as occurring during the curing of corn fodder.

About three years ago Prof. W. A. Henry, of the Wisconsin Experiment Station, called attention to the results of tests made there to determine the amount of dry matter in green and dry corn fodder; which showed that the cured fodder lost not less than twenty per cent. of its dry substance before it was fed out as compared with the dry matter in the same fodder when it was cut down green in the field. The fact of the loss was well attested; but it was practically discredited because no sufficient cause could be assigned for it.

But in 1881 Prof. Geo. A. Cook, of New Jersey, had noticed a loss of dry substance in corn fodder under similar circumstances, and that the loss fell almost entirely upon the soluble carbohydrates. (N. J. Expt. Sta. Report for 1882.)

Prof. E. H. Farrington, of the Illinois Station, records a decrease, not definitely accounted for, of 17.3 per cent of dry matter in the whole plant cut and analyzed two weeks after the ripening of the grain. ("Science" April 15, 1892, p. 212.)

Polished Stone.—There is a gradation of chipped articles into those which are polished, often by an intermediate picking. Celts and gouges quite frequently show this. A pebble was first chipped into a form that might be used. Then it was neatly picked, at leisure moments, after being sharpened. Still in use, the final polish was given, as time allowed. The result is that rudeness of implements is no certain sign of age. The finest and rudest may lie side by side, and were used together. Every form of the gouge and celt is found in New York, from the very smallest to the largest size, and the materials for both vary from the poorest to the most elegant. A frequent local form is quite angular, having six faces, one of them very broad. Those of striped slate flare, like the white man's hatchet. The long, tapering gouge is the most common, but there are several broad forms.

Allied to these is a long stone article, rare, and mostly found in Onondaga County, which much resembles a butcher's steel without the handle. An Indian friend said the old men told him that they formerly used such a stone, with a bow-string, in making fire. It seems too frail for other uses.

Mullers, polished on one or both surfaces, or combining the hammer stone, seem of early use. Allied to these are the large bowlders, on which tools were sharpened, forming shallow depressions ; and the smaller stones, plainly used as whetstones. The so-called sinew stones are rarer, but were of recent use.

Every form of stone tube is found, and almost throughout the State, but most abundantly in central New York. It would require too much space to describe the many interesting examples, some of which are of striped slate. The largest and most remarkable are of sandstone and slate, and were found on Lake Champlain, the Mohawk River, and Otisco Lake. The shorter ones are drilled from both ends ; the longest from one. Some unfinished ones have been found.

A large ceremonial stone, of my own, plainly shows its mode of making. It is of a hard, light green stone, and has been picked into a form like that of a double hatchet. Polishing was then begun, and a little was done at this. Then drilling began with a tubular implement, resulting in a shallow circle, enclosing a core. There the work stopped. No form of these ceremonial stones has ever been figured which does not occur in the central part of the State, but all such things are rare in the Mohawk Valley, which travellers avoided, and where for ages no man lived. Along the great lakes, and the St. Lawrence, they are often found. While all finished articles of this kind are perforated from top to bottom, I have seen but one with lateral holes, when unbroken.

A curious little thing I picked up by Onondaga Lake. It was a small cup of sandstone, about an inch across, and perforated through the bottom. The form was nearly that of a coffee cup. One similar was found in California, and they seem to have been pendants. Quite rarely small and pretty cups or bowls of striped slate appear. In other materials they are more common. Along with these may be placed the well-known potstone vessels, usually with projecting handles. Fragments of these are abundant in many parts of the State, usually perforated, and often with a secondary use. Of course they were imported, and are found only by navigable waters. They were not used by the Iroquis, nor do they occur in connection with brown earthen ware. Many sites have no traces of any kind of vessel, and it is quite possible the hearthstones, so conspicuous in some places, may have been used in heating water in vessels of bark. These stone hearths were not customary with the Iroquis, but they dug holes in the ground for their fires, so that recent relics are often deeply imbedded. Depth has little to do with antiquity.

The half-circular polished slate knives are of general occurrence, but those with a thickened back are rarer than the simpler form in New York. Another polished slate knife is locally termed a slate arrow, being barbed, and with a similar outline. These vary much in shape, size, and material, being sometimes very delicate. As far as known, they seem confined to both sides of Lake Ontario, the St. Lawrence, and Lake Champlain. A number have been found in Canada, but they are most common near the Seneca and Oneida Rivers. They have curving edges, and were used with a handle.

Stone plummets are also somewhat local, but often of fine finish and quite variable design and material. Most of them have been found about the lower ends of Oneida and Onondaga Lakes, but they have a general resemblance to those of Ohio. Gorgets, variously perforated and formed, are scattered all through the land, from the Atlantic to the Pacific, and yet their use has not been determined. They are often of fine forms and materials. Between these and the bird-shaped stones is another class of perforated articles, somewhat pyramidal in form, and sometimes with a nipple at the top. These are comparatively rare ; quite as much so as those called boat-shaped.

The bird amulets belong almost exclusively to the country drained by the great lakes, though they have been sparingly found in New England and New Jersey. Some very odd forms occur. The simplest is almost a bar, always with a sloping perforation at each end. A more common form is narrow, with a raised head and tail. Others are quite broad, with projecting knob-like ears ; and similar ones are quite flattened. I have figured many of these in New York and Canada. They are usually of striped slate, and most abundant on both sides of Lake Ontario, where they are sometimes very large and fine. They may have been fetiches. Another article of slate is long and triangular, like a bayonet.

Among the ruder implements are balls, ground or chipped into facets, or with grooves for use in war clubs, but many minor articles may be passed over. Not so the pipes of stone, of which the larger part of New York specimens are comparatively recent. Until the coming of the whites most New York pipes were of clay, the Naragansetts making those of stone, but with the use of steel tools stone advanced in use. Some early examples of such pipes are found, a few of them unfinished. Platform pipes, like those of the mound builders, are hardly rare west of the Mohawk Valley. Catlinite pipes may be called modern, as that material seems to have been almost unknown in New York until near the close of the seventeenth century. By that time ornaments of red slate and pipestone became quite the fashion. The former abound on most recent sites, and are often quite tasteful.

Copper Articles.—Many fine examples of native copper articles have been collected, some very large, but the socket for receiving a handle is rare in these. They are of early date. When the whites came, brass, copper, and bronze became the rage for use and ornament ; with a fair allowance of iron, pewter and lead. Many things were made on the spot, and shreds of sheet copper occur on most Iroquis sites. Pieces of this, finely notched, supplied good saws ; cut into triangles and perforated, it made good arrows ; rolled into cones, it furnished bangles, while more elaborate ornaments came in other ways. Not far from A.D. 1700, silver replaced bronze for ornaments and has but lately gone out of fashion.

Shell, Bone, and Horn.—Early articles of shell are quite rare in the interior of the State, though occasionally found. I have not seen half a score of shell articles that could be safely placed before A.D. 1600, leaving out the Unio shells found on so many early sites, and which were rarely worked at all. Of shell beads, used in belts, the

Iroquis probably knew very little until they had them from the whites. In the eastern part of the State the case was reversed. Small shell beads, made by Indian and not by white methods, are quite rare. They are drilled from both ends, and I have seen very few. In Cayuga County, however, some very large beads have been found which may be early. All known wampum belts are modern. Once introduced, the Iroquois used beads lavishly, and recent gorgets, beads, and ornaments of shell are frequent. Bone and horn were used earlier, and were favorite materials with the Iroquis. Ornaments made of perforated skulls appear in Jefferson County, and carved bones and horns in other places. After the Iroquis obtained knives and saws they did some tasteful work in this way. Quite handsome combs were made, usually symmetrical. Some unfinished examples show how they were made. Just before European trade vigorously commenced, they formed a few barbed fish-hooks, but I have known but four of these. The hook with the knob, but without the barb, is earlier, and quite rare. I think the barb came from a knowledge of the white man's hook, especially as one of these was from a place occupied about A.D. 1600. The four hooks were found respectively in Canada and Jefferson, Madison and Onondaga Counties. Harpoons of bone or horn are mostly recent, though not invariably. They were used by the Iroquis. Recent ornaments of bone are conventional or realistic. Mingled with them are Venetian, porcelain, and glass beads, and all kinds of trinkets. Jesuit rings have a prominent place.

Earthenware.—Most villages, and many camps, have afforded much earthenware, occasionally found entire in graves. Vessels are sometimes quite large, and often beautifully ornamented with dots and lines. Pottery is valuable in connecting sites. On a few vessels, three or four dots inside of a diamond or triangle, suggest the human face. Human faces or figures at the angles of earthen vessels, were in fashion among the Onondagas and Mohawks late in the sixteenth and early in the seventeenth centuries. The fashion lasted about thirty years, but this absolutely fixed the age of two important sites. These figures also have peculiarities connecting them with other styles, and are usually symmetrical, but in one Mohawk example one hand is raised, and the other turned down. Pipes often suggest a similar connection, or reveal striking individuality. A series of curious many-faced pipes from one neighborhood, could have been made by only one man, and others, far apart, have a similar personality. Raised figures are common on Iroquois pipe bowls; but in the earlier ones they face the smoker, in the later they are turned from him. In one instance a spirited panther's head is turned to one side. This was from a grave of the transition period, which had another with an eagle turned from the smoker. Pipe stems are often ornamented with lines and dots, and others have projecting lines running along both sides. The variety is endless. The English freely distributed the common white pipes, and they appear on most recent sites. Sometimes they are found of pewter, brass, or iron.

Among modern pipes I have an Indian one made from an immense deer's antler, which is well carved, and was finely painted in its day. Detached ornaments of terra cotta are sometimes quite artistic, and may represent the whole or some part of bird or beast. Such things must be looked for only in cemeteries or villages. It is a mistake, however, to expect relics in all graves, for scores of early tombs have been opened which had no trace of any article. Equally erroneous will it be to look for fixed modes of burial. They varied greatly within a limited space and time. One occurs to me where a young person of distinction was interred head downward.

Some of the finest articles have been found at a distance from villages and camps; often in low places, as though lost in hunting or war. This reminds me that the common opinion that broken implements necessarily indicate battle fields, is another error. In villages they were often broken accidentally, but in the great New Year's feast of the Iroquois and Hurons, wholesale destruction might be a matter of course.

I have seen a few beads of baked clay, as well as of stone. The latter are formed from fossils. In one case, in Cayuga, a fossil shark's tooth had become an arrow, and curious stones have often been slightly worked to increase a primary resemblance. A few counters of bone or clay —the latter sometimes made from broken earthenware—have been found on Onondaga sites, probably used as in the peachstone game. In this game, of course, other materials were at first used; perhaps the deer buttons which are not yet laid aside.

It may be remarked that while knives and punches were used in decorating vessels, some ornaments were formed simply by pinching the clay on the sides of vessels, and on some fragments the impression of the thumb and finger plainly remains. Traces of basket work are rare.

SARCOLOGY: A NEW MEDICAL SCIENCE.

BY WALLACE WOOD, M.D., PROFESSOR IN THE UNIVERSITY OF THE CITY OF NEW YORK.

THE recent experiments of Brown-Séquard and Dr. Hammond in injecting extracts of flesh into the blood, go to show that there may be a science of the organism, which is neither anatomy nor physiology, nor yet histology nor chemistry, and yet which may be founded upon facts and laws as sound as those upon which are based its sister sciences.

The elements with which chemistry deals are atoms and molecules; histological elements are cells, fibres, membranes and tissues; anatomy describes organs and systems; while morphology conducts the mind to higher combinations, such as antimers and metamers, the person, the couple, and the colony, the individual, and the race.

Sarcology discarding all forms and tissues, comes down, as it were, with blows of the hammer upon the solid and naked flesh, driving it down to a hard basis. It reduces this flesh to pulp, and with such pulp seeks to reconstruct the organism. In Brown-Séquard's laboratory we have brain juice and testacular juice; from Dr. Hammond we receive scientific elixirs of life labeled Cerebrine, Cardine, Teotine. Inject these into the river of life, the *milieu interne,* and each goes to its proper part and reconstructs it.

How many kinds of flesh are required to make man? Four; one for each kind of life force. One to bear the strain of each of the cardinal forces, excitation, motion, growth, production.

These forces work through nerve, muscle, vessel, and gland.

These powers are radical or elementary. In organic life there is a nervous or excitative tendency, a muscular or motor tendency, a vascular or tubular tendency, which is toward nutrition, construction, growth, and a glandular or epithelial tendency, toward efflorescence, effusiveness or production. Nerves are the agents of excitation, muscles are motor agents, tubes are the agents of construction, glands and parenchymes or epitheliums are the agents of effusion, efflorescence and productivity.

The science of sarcology rests upon the foundation of the four radical parts of the organism, the four elementary kinds of flesh. If any one is in doubt concerning the doctrine, let him dissect the serpent, a vertebrate comparatively simple, and the one best generalized. I have spent two summers in this kind of work and have found it most profitable.

Examine the serpent in the embryo first. One easily defines four long lines thus:

1————
2————
3————
4————

The first is a white line of nerve flesh, the second a livid line of muscular flesh, the third a red line of vascular flesh, and the fourth a yellow line of glandular flesh.

In the adult these four radical elements appear also in long lines, and one forgets to look for details of organs and functions, for he sees before him a grand generalization made by nature herself. Here is the long white line of nerve, the flesh of excitation, next a gross elongate contractile mass, say three feet in length, the motor flesh, two long tubes, one alimentary the other sanguiniferous, nutritive tubing, constructive flesh, and finally a chain of elongate soft masses, each serpent-shaped, lung, liver, kidney, ovary, constituting the effusive or productive flesh.

Each of these being reduced to impalpable powder, if made into extracts, we would have serpent neurine, musculine, vasculine, glanduline.

Presumably we must take it for granted that the flesh of the serpent is not appropriate for human veins, as we do not put it into the human stomach, though we do that of the turtle, but the simplicity of the organism makes it a most delightful subject for the man of science to contemplate. Along that white nervous line lies the brain, the soul, the spirit of the creature, the power of excitement; by theory injected into the veins of other creatures it ought to raise the spirits and the power of excitement. Along the livid contractile line lies the muscular power. In the third, or vascular line, we find the heart and the vitality. Injection of this flesh should increase vitality, the power of living and growing,—a serpent, like a cat, dies hard. The heart and intestines of felines also offer a subject for investigation. In the fourth line, finally, that of the soft and melting flesh, we see the force of effusion and efflorescence, or productivity. Forced feeding of the veins or lacteals with this flesh ought to raise the effusive and productive power.

For purposes of experiment the rabbit would in many places be a more convenient animal than the guinea pig of Brown-Séquard. A number of these animals being provided, the brain and nerves are thrown into the first pile, so to speak, as spirit flesh, the muscles into the second as motor flesh, the heart, veins, arteries and intestines into the third as vital or vigor flesh, and the lungs, liver, kidney, ovaries, testes and mammary glands into the fourth as productive flesh.

These four radical parts being treated by Brown-Séquard's method would produce nerve juice, muscle juice, vessel juice and gland juice. Being treated by Dr. Hammond's process with boric acid, glycerine, and absolute alcohol, the result would be four radical or elementary extracts, neurine, musculine, vasculine, glanduline, calculated respectively to raise the spirits, the energies, the vigor or vitality, and the effusive power.

Each of the grand divisions of the little kingdom of man has its capital or seat wherein each special kind of force is concentrated. The nervous centre is the cerebrum, or highest pair of nerve ganglia; the muscular centre, somewhat less marked in man, is clearly to be distinguished in the breast of wild birds, and in the rump of the cervidæ; the heart is the vascular centre, the seat of vitality and vigor, the culmination of nutritive force; while the germ or sperm glands, or generative flesh, may be regarded as the glandular culmination of the organism.

In these organs, then, brain, breast (of birds), heart and ovaries or testes, we have special concentrations of life's radical forces, excitatory, motor, constructive and generative, and thus, if instead of taking the whole of the flesh for the manufacture of carneous extracts, one selects the concentrated parts, using these alone, he will, in place of making neurine, musculine, vasculine and glanduline, produce cerebrine, pectine, cardine, testine, which thus ought to be a higher essence of the flesh. For these specialized flesh masses in nature present to us the highest examples of force excitant, energetic, constructive and generative.

How to grasp and bottle these forces and with them perform the scientific miracle of transubstantiation, is the question for those who seek an elixir of life, making these flesh masses by means of extracts the vehicles through which to transfer these forces from animals to man.

The ancient Romans were convinced of the truth of the dictum that each part nourishes a part. As an example the udders of cows were eaten by them as emotional food. The science of sarcology and the new way opened up by Brown-Séquard and Dr. Hammond suggest higher possibilities. Who knows but some day we may inject into our veins the breasts of birds and the heart of the lion, as modes of raising human spirits and energies.

HISTORY OF SCIENCE IN AMERICA.

BY JOHN READE, MONTREAL, CANADA.

The period between 1876 and 1889—the centennial period, it might be called—was the occasion of many retrospects, touching the development of letters, law, the constitution and various branches of science within the Republic. Long before the later limit of this period had been reached, the eyes of students had begun to contemplate, with admiration, an anniversary of still more pregnant suggestiveness, and surveys covering the interval between the Columbian discovery and the present have begun to appear. In an age of specialists, such as ours, comprehensive records of progress, like those of Drs. Whewell and Draper, are going out of fashion. Where they survive, they mostly take the cyclopedic form, each contributor dealing with a special department of knowledge. If we were to have a history of scientific progress in the new world during the last four centuries, it would probably be the product of such collaboration.

In compiling such a history, it would be necessary at the outset to draw a line of partition between such scientific research as, though conducted on this side of the Atlantic, was due to European initiative. In geography, for instance, the services of Columbus belong, in the main, to Europe, and of European countries, Spain has the best claim to the honor of them. But where, after his primal discovery of cis-Atlantic land, he chose fresh starting points for exploration and thus enlarged his knowledge by its growth on American soil, America may at least share in the distinction. Again, whatever additions to geographical knowledge or natural history were made under the auspices of viceroys or governors after the settlement and political organization of the West Indies and of South, Central and North America, may fairly be set down to the credit of American science. What is not American is Spanish, French or English, or less frequently, Portuguese, Dutch or Scandinavian.

The gathered facts which, after due sifting, amendment and classification, might be accepted as of scientific value, relate to geography, geology and mineralogy, meteorology, botany, anthropology, philology, mythology and folk-lore. Some of these terms were not in use in the early generations of American settlement; nor of science, in our modern sense, was there, apart from pure mathematics, and its applications, a great deal that was worthy of the name. The germs, however, were there, and the scientific method of to-day sometimes makes them fructify in ways that the authors never dreamed of.

The materials for a history of the sciences in America are ample enough. If we have regard to any one of the three main divisions of the twofold continent as occupied by Europeans—New Spain, New England and New France—we happily find that, in every instance, among the pioneers, there were educated observers who, although their mental horizon was contracted by prejudices characteristic of their time, country, creed or party, or all conjoined, were able to express their thoughts in intelligible and often in vigorous language. In some cases these scribes, priests for the most part, though sometimes laymen, have given us their impressions of the aborigines with whom they came in contact. A few of these latter—or at least half-castes—had also learned the accomplishments of the new-comers and have left us what purport to be traditions of their race. It is also of importance, for the subject under consideration, that the most learned and enlightened of the conquerors won the sympathy of the natives, and, although their treatment of them was not always such as science would approve, they nevertheless elicited from them information that science can turn to advantage. If we seek to know where the materials for the history of scientific progress in America may be found, it is enough to mention Mr. Justin Winsor's History. The critical essays on the sources of information in these eight volumes will, if wisely used, guide the inquirer along the path by which science, in all its branches, developed during the first three centuries of civilized life and labor in the new world.

A beginning of such an investigation for the northern part of the continent was made a few years ago simultaneously by two members of the Royal Society of Canada. Singularly enough, though one (Professor Laflamme) is a geologist, and the other (Professor Penhallow) is a botanist, they both chose the same line of inquiry—the progress of botanical research in Canada. Professor Laflamme made a single savant (Michel Sarrazin) the centre of his study, while Professor Penhallow undertook to trace the successive steps by which plant-lore was developed in Canada. Although in each case the ground, both biographic and historic, was virtually unoccupied before, each winter succeeded in clearing a considerable tract for the benefit of the historian of science. The scientist trained in the methods of the present meets, in such surveys of the past, with much that makes him smile, much, perhaps, that tries his patience, but occasionally he discovers an anticipation of knowledge long ascribed to later workers. Sarrazin was a pioneer in comparative anatomy as well as botany, and his observations were highly esteemed by the French Academy of Sciences. To-day he is chiefly remembered in connection with the order of polypetalous exogens (*Sarraceniaceæ*) that bears his name. Another botanical name due to a Canadian scientist of the French regime is *Gualtheria.* Again, *Diervilla* was the name given by Tournefort to a species of bush honeysuckle, out of compliment to Diereville, who wrote the "Voyage du Port Royal de l'Acadie." Kalm, whose assiduous services to science in North America are commemorated in *Kalmia,* spent considerable time very pleasantly with one of the most learned of the governors of the old regime, De Galisounière.

If we begin with the "Voyages de Decouverte" of Jacques Cartier, recording impressions made on an explorer of the days of Francis the First, and follow the course of settlement, organization and research down to the time of Kalm's visit, soon after the publication of Charlevoix's history, we are not likely to miss frequent indications helpful to the historian of scientific progress. Sir William Dawson's "Fossil Men" is based on the discovery of remains on the site of the Indian village of Hochelaga, which, after an interval of nearly three centuries and a half, confirmed the truth of Cartier's hitherto unsupported story. A few years later the astrolabe of Champlain was found in the track of his journey to the *Mer Douce,* not far from the banks of the upper Ottawa, a prize for more than the antiquary. Faulty as he is, when judged by the rigorous standard of modern science, Champlain has left us, in his writings, a rich mine for the student who would compare things old with things new. In his rough, practical way, he was a watchful observer, and if his handling of the pencil is clumsy, he uses his pen for the most part with clearness and point. In the very year of his death, just a century after Jacques Cartier's visit to Hochelaga, there was published at Paris a book entitled *Canadensium Plantarum Aliarumque non dum Editarum Historia,* by Jacobus Cornutus (Jacques Cornut), whose share in the development of the knowledge of new-world botany is the subject of a paper read by Professor Laflamme before the Royal Society at Ottawa last May and now in course of publication. Creuxius (Du Creux), who wrote his history of Canada in Latin, pays some attention to its natural history and enumerates "*arbores plantasque cujuscunque generis quas edere terra sponte solet.*"

To the Jesuits' *Relation,* the *Voyages* of La Houtan, Lafitau's *Moeurs des Sauvages Ameriquains Comparees aux Moeurs des Premiers Temps,* the anthropologist and folklorist may go as to sources of knowledge not to be found elsewhere. Lafitau is, indeed, for North America, the father of comparative mythology. He wrote when opportunities of observing the manners and customs, ceremonies and habits of thought and belief of the wild tribes of Canada were still abundant, and he has dealt learnedly and, so far as was possible in his day, liberally, with his themes. His two volumes are still well worth a careful study. Besides his own experience of savage life, he had derived great benefit from the gathered knowledge of Père Garnier, who had spent no less than sixty years among the Indians, and knew the languages of several Algonquin tribes, the Huron and the five dialects of the Iroquis. Lafitau found that if the study of ancient authors threw light on the usages of the Indians, the latter also enabled him to understand a great deal touching the barbarous races of antiquity, to which he must otherwise have remained a stranger. Charlevoix, besides describing and illustrating a considerable number of new-world plants, gives fruitful attention to American ethnology and the customs of the aborigines. The reports of some of the Intendants, the histories of Boucher, Sagard, Le Clerc, Dollier de Carson and other contemporary records of the old regime contain hints that the student of scientific development may turn to account. Nor would it be wise to ignore the records, both French and English, of far-northern and far-western exploration, missionary, military or commercial, during the same period. The story of the La Verendoye family, with its romance and its tragedy, and those persistent Hudson Bay Co. voyages in search of a northwest passage, with the instructions ever ending in prayer for successful discovery and safe return, have also their scientific significance for those who do not despise the day of small things. Some of the worthiest heroes of science were those who moved in the long, slow march, which, in our more fortunate generation, was to be so wondrously quickened. And the grandest triumphs, from the moral standpoint, belonged to some of those who persevered in the face of failure, knowing that not to them, but to their successors, was the victory destined to fall. The records of scientific progress in America abound in such heroism, and the rescue from oblivion of some of its forgotten heroes would be not the least reward of the patient inquirer in these unfrequented paths. If what Jules Verne calls *la decouverte de la terre*, that is, the gradual ascertainment of the physical features, extent and habitability of the globe, be worthy of being classed as science (and in what scientific society is not geography recognized?), then what the old regime has contributed to the opening up and civilization of this continent is no scanty share. No less than ten states of the Union, and every province in Canada, save British Columbia, were first occupied by French pioneers, first described by French writers. And in this record of exploration and colonization, extending from 1534 to 1764, we find such names as Cartier, Champlain, La Salle, Duluth, Iberville, Joliette, Marquette, La Mothe, Cadillac and those of many another to whom mankind is deeply indebted. This is the merest outline of what, if a history of science in the new world were undertaken, the inquirer would find helpful and more or less valuable in the records of the northern dominion. On another occasion I hope to give some details from these records as indications of their scientific worth.

BRITISH STONE CIRCLES—IV. SOMERSETSHIRE AND DORSETSHIRE CIRCLES.*

BY A. L. LEWIS, PRESIDENT SHORTHAND SOCIETY, LONDON, ENGLAND.

One of the most interesting groups of circles in England is situated at Stanton Drew, about seven miles south from Bristol. It comprises the remains of three separate circles, two of which have short avenues, a cove, or group of three stones, like those at Abery and Arbelow, a large single stone to the northeast, like the "Friar's Heel" at Stonehenge, and two other stones at a greater distance; and, that these were all parts of one great whole, and were not constructed without reference to each other, is shown by the facts that a line from the "cove" in a direction fifty-four degrees east of north will pass almost exactly through the centre of the great circle to the centre of the smaller circle to the northeast of it, while a line from the centre of the southernmost circle in a direction about twenty degrees east of north will pass almost exactly through the centre of the great circle to an outlying stone called "Hauteville's Quoit."

This latter stone is the first which is encountered on the road from Bristol, and soon after passing it the remains of the great central circle and of the smaller northeastern circle, with the short avenues attached to them, will be seen in a meadow on the other side of the little river Chew, which is crossed by a bridge near by. The northeastern circle is ninety-seven feet in diameter, and consists of nine stones, and there are, besides fragments, eight other stones in the short avenue which goes from it in a direction a little south of east. On the south of this avenue, but not connected with it, another avenue, of which only five stones remain, leads in a southwesterly direction to the great circle, which was about 368 feet in diameter, and of which only twenty-four stones remain; these are, necessarily, a considerable distance from each other, so that it requires a little care to follow the circumference of this circle. The nearest part of the southern circle is 460 feet from the outside of the great circle, and its diameter is 145 feet (which is also about the distance between the circumference of the great circle and that of the northeastern circle); twelve stones of the southern circle remain, but all fallen, and it is cut through by fences, and is, consequently, more difficult to find, and to trace when found, than either of the others. The "cove" is 470 feet, eight degrees north of west, from the circumference of the southern circle, and is not far from the church; it consists of three stones, two upright and one fallen, which form three sides of a square, like the coves of Abery and Arbelow, but it differs from them in facing southeast instead of northeast. Some have thought these stones to have been part of a sepulchral chamber, but they are too thin in proportion to the height of the tallest one (ten feet), and could only have been covered by a very large mound, of which no traces remain; this, however, is a question respecting which the visitor can form his own opinion. If not covered they might have formed a sanctuary open to the rising sun in winter, while the circles were devoted to his worship in summer.

The northeastern circle is better preserved, and is formed of larger stones than the rest of the group, some of the stones composing it being nine feet high, and broad and thick in proportion.

The measurements and compass bearings (true, not magnetic) given here are mostly taken from the beautiful plan made by Mr. Dymond, C.E., F.S.A., and published some years ago in the Journal of the British Archæological Association.

It has been suggested that the avenues are remains of a number of circles concentric with and surrounding the northeastern circle. Mr. Dymond shows pretty conclusively that they were avenues and nothing else, but the visitor may investigate this point for himself.

At Wellow, seven miles south from Bath, and about ten east from Stanton Drew, there is a large tumulus with a long gallery and six small side chambers, built and vaulted with small stones uncemented.

In passing from Somerset to Dorset we find no stone monuments equal to those just described. At Winterbourne Abbas, four or five miles from Dorchester, is a small circle called the "Nine stones," twenty-eight or thirty feet in diameter (not in height as stated, by the Post Office directory), six stones only remain, two of which are six feet high, the others half that size or less. Warne, in his "Ancient Dorset," mentions "a tenth stone which the eye detects just peeping through the long grass on the northeast side."

At Gorwell, on Tennant's Hill, four or five miles beyond Winterbourne Abbas, and about ten southwest from Dorchester, is a ring consisting of eighteen stones or fragments, all prostrate, the largest being eight feet long; the figure which would touch most of them, so far as they are at present uncovered, would be an oval, of which the diameters would respectively be eighty-seven and seventy-eight feet, but they are much overgrown with turf, and, if cleared, it might be found that a circle of from eighty to eighty-two feet in diameter would touch most of their original positions. I was not able to find any outlying stone or other remarkable feature to the northeast of this circle, but there is a thick plantation on that side, which shuts out the view of the surrounding hills, and within which a stone or stones may be buried; there are, however, two outlying stones about 140 feet south from the circle.

At Gorwell, about half a mile southeast from the circle just described, are the remains of a sepulchral chamber and tumulus, with three other stones called the "Grey Mare and Colts," and at Portisham, two miles from Gorwell, is a dolmen called the "Hellstone," which appears to have been inaccurately "restored." There are also remains of a circle or circles at Poswell, six miles southeast from Dorchester, and earthworks nearer that town, known as "Maiden Castle" (a very fine camp), "Poundbury" and "Maumbury Ring."

*I. Abury appeared in No. 529, March 24.
II. Stonehenge appeared in No. 537, May 19.
III. Derbyshire Circles appeared in No. 545, July 14.

SCIENTIFIC RESEARCH WORK IN AMERICA.

BY ALBERT SCHNEIDER, UNIVERSITY OF ILLINOIS, CHAMPAIGN, ILL.

I THINK it quite necessary to point out some of the difficulties encountered in successfully undertaking any scientific research work in America. In the first place we, as a nation, are too practical and short-sighted to make thorough scientists. We are too much engrossed with the present to undertake anything which promises only a probable reward in the distant future. In the second place, we lack sufficient scientific training. Boast as we will, we must admit that Germany, France, England, and even Russia, are a long way in the lead in scholarship. From this lack of training we must content ourselves with going over the ground already gone over by European scholars. Nor is this because of our "infantile" condition. There is no plausible reason why the American mind should not be as ready of comprehension and understanding as any other. We have incipient philosophers who might become equal to or superior to any in the world. The great trouble is that they imagine themselves superior while they are yet in the embryo stage, and as a natural result become fossilized embryos. This is not always the case, but it is true in the majority of cases. Another great drawback is the uncertainty of holding a position when once taken. This deadens interest and absolute.y prevents the possibility of undertaking any work which must of necessity be long continued. In Germany the professor is almost certain of holding his position a life-time if he so desires. As far as his position is concerned he is almost an absolute monarch. The nature of his work is never inquired into by the laity. He is given a position because it is known from his preparation and training that he is fully competent. This enables him to begin a work which may require generations for its completion. Lastly the management and directorship of scientific laboratories and experiment stations is too often placed in the hands of men wholly incompetent, considered from a scholarly standpoint. They can not comprehend the nature of scientific research work nor understand the benefits that might be realized therefrom.

These, in brief, are some of the main difficulties which beset our scientific research work. It is not my purpose to belittle intentionally the work we do or have done. Nor do I believe the prospects for the future to be gloomy and hopeless. America is destined (in time) to lead the world in science and all other branches of learning.

LETTERS TO THE EDITOR.

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

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

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

TEMPERATURE IN STORMS AND HIGH AREAS.

IN the August number of the *Meteorologische Zeitschrift*, p. 314, Dr. Hann complains that I have "obviously and wholly misunderstood" (*offenbar ganz missverstanden*) a table he has recently published. As I have copied a part of this table in *Science*, April 14, 1893, p. 204, I must ask indulgence to explain matters. My statement is "I give here the temperatures in both maxima andminima during the colder months," the original table indicates that these maxima and minima were at Sonnblick and not at the base. I take pleasure in adding this statement. It seems almost impossible to comprehend this position that Dr. Hann has taken. Are we to understand that these conditions are very different at 3100 m. from those at the same time at sea level? This is exactly what has been repeatedly shown, namely, that the temperature change is about a day ahead at the high station, and the pressure change about half a day behind, and for this reason it is impossible to directly compare pressure and temperature at high stations, but Dr. Hann has strongly combatted this.

However this may be, there is still one other point to be considered. Fortunately, in the original tables there are given the pressures at sea level at the exact times, at which these maxima and minima of pressure occured at Sonnblick. These are 774.5$^{mm.}$ and 754.2^{mm}, respectively, while the base temperatures are 2.°0 C and -0.°8 C., respectively, that is, during the prevalence of very high pressure at sea level the temperature is 2.88 C (5.°0F) higher than during pressures 20.3$^{mm.}$ (0.80 in.) lower. This is contrary to the usual law over the whole temperate regions of the earth and shows a serious error in these investigations.

It seems to me this point is one of the easiest that can be settled in the whole science of meteorology. I hold my position strenuously right here, for this may be a key for solving one of the most serious puzzles that has been found in meteorology since it has made any pretense to being a science. The proposition seems very simple and, in fact, almost trivial, but it is in reality vital. If Dr. Hann insists that his studies are correct, then it devolves upon him to explain this serious contradiction. It would appear that he does see the difficulty and tries to explain it, but I submit, that, in doing so, he has not removed it at all.

H. A. HAZEN.

Washington, D. C., Sept. 11, 1893.

SHARKS IN FRESH WATER.

IN the issue of *Science* for August 25 is a question by Mr. C. H. Ames, which has not been answered. As the subject in question is one of quite general interest, I take pleasure in giving the desired information.

It is well known to ichthyologists that sharks do live in fresh water, and it is remarkable that such forms are representatives of a family whose species are to a large extent pelagic—the Galeids or Carchariids; they belong to a group very generally known as the genus *Carcharias*, but believed by others to be divisible into several genera. Numerous accounts have been published of the occurrence of members of this group in fresh water in various parts of the world; it is sufficient to refer to several readily accessible, viz.: *Nature*, V. 13, pp. 107, 167, 1875, and V. 29, pp. 452, 573, 1884. It is further noteworthy that a shark and a sawfish (*Pristis*) frequently reside together in fresh waters of widely distant regions, as in the Philippine Islands, Australia and Lake Nicaragua.

The existance of a shark in Nicaragua was recorded by Oviedo a few years after the discovery of that country and had frequently been referred to subsequently. It did not receive a published name, however, till 1877, when it was described as *Eulamia nicaraguensis* by Gill and Branford (Proc. Acad. Nat. Sc. Phila., 1877, p. 191). A few years afterwards the species was again described and figured by Lütken (as *Carcharias nicaraguensis*), and it was stated that the name *Carcharias lacustris* had been proposed for it by Oersted as early as 1848, but never published. (See Vid. Meddelelser fra Naturhist. Forening, Copenhagen, 1879-80, p. 65, etc.)

Further details may be found in the works cited.

THEO. GILL.

Cosmos Club, Washington, Sept. 10.

Sharks in Lake Nicaragua.

In a letter in the issue of *Science* for August 25, 1893, Mr. C. H. Ames raises the question of the existence of sharks in Lake Nicaragua and seems inclined to attribute to fiction the accounts of their presence which have from time to time been given. The reading of Mr. Ames's letter reminded me of a visit to this lake made by my friend, Mr. Charles W. Richmond, of the U. S. National Museum, and of the narrative he gave me, on his return, of his personal experience with the sharks. Mr. Richmond passed a year in Nicaragua in making natural history collections, and spent considerable time on Lake Nicaragua and the two rivers, the Frio and San Juan, which connect with it on the south; his visit occupied parts of the years 1892 and 1893. He has kindly furnished me some interesting notes on the fresh-water sharks inhabiting Lake Nicaragua and its tributaries, which I venture to present, although a contribution on this subject from the erudite Professor Theodore Gill, which I understand has been sent to *Science*, may render the present remarks supererogatory.

There seems little ground at this time for doubting the existence of sharks in this region. They are mentioned in the works of Belt, Squier, and other writers on Nicaragua and Central America, they are so well known to the inhabitants of the country as to occasion little comment; and they have been recorded and described by several ichthyological writers.

The information gathered by Mr. Richmond and his personal observations tend to indicate that the sharks are quite abundant. Two well-informed men, whose business was the hunting of wading birds for their plumes, reported to him that they frequently saw sharks, and the captain of one of the lake steamers, a resident of that region for more than thirty years, spoke of sharks as being particularly numerous near Granada, where they remain in the vicinity of the steamer when it is moored there. At San Carlos, two Americans, who made frequent fishing excursions on the lake, mentioned the occurrence of sharks as not unusual.

Mr. Richmond saw a shark in the Rio Frio many miles from its mouth. This river flows into the San Juan just below the lake; on some maps it is incorrectly made to empty into the lake. The example in question swam back and forth near the bank of the river, and did not take alarm even after several balls had been fired at it from a rifle. It was in plain sight, and Mr. Richmond had an excellent opportunity to estimate its length, which appeared to be about five feet. During his voyage down the river in a row boat, his companion, a Mr. Hausen, stopped one morning to fish from a snag in midstream. The fish bit well and he had some excellent sport. Once he attempted to haul in a very desirable fish, and had got it partly out of the water, when a shark seized it and took both fish and hook. The shark came very near to the gentleman and presented its head in uncomfortably close proximity to his foot. Mr. Hausen had made a number of trips up the Rio Frio and had seen sharks there before.

Sharks are found in all parts of the San Juan River, which drains Lake Nicaragua. They are particularly abundant at Castillo Viejo, where the telegraph operator of the canal company whiles away his leisure hours in catching them. Mr. Richmond saw several at this point, doubtless attracted by the flesh of a monkey's skull which he threw into the stream. The Machuca rapids below Castillo make it impossible for salt water to reach that place, and the sharks seen were presumably the same as those infesting the lake.

The shark inhabiting the lake apparently does not reach a large size, as we are accustomed to judge sharks on our coasts. Four or five feet seems to be the average length attained.

The presence of this representative of a typically marine order of fishes in Lake Nicaragua is not the only interesting feature of the fish fauna of this body of water. Mr. Richmond refers to another order of salt-water fishes, closely related to the sharks, which is represented by a large species, the sawfish (*Pristis*). The plume hunters before mentioned reported seeing individuals about three feet in length, and their occurrence was also confirmed by Captain Augustine, of the steamer "Managua" Systematic investigation of the fauna of this lake will doubtless disclose the existence of other animals, apparently out of their element, going to prove that at some remote period the present lake bed was simply a part of the sea bottom, which was thrown up by volcanic action with the supernatant water and its inhabitants.

In the Escondido River, which enters the sea on the Mosquito Coast, Mr. Richmond found sharks as far up as De Rama, sixty-five miles from its mouth. During the dry season, a period of very brief duration, the water is brackish at high tide at this distance. Several sharks, from two to four feet long, were caught here while the water was perfectly fresh. It is not known, however, that these were of the same species as those inhabiting the lake. HUGH M. SMITH.

U. S. Fish Commission, Washington, D. C.

AMONG THE PUBLISHERS.

MESSRS. D. APPLETON & Co.'s preliminary autumn announcements include the following books: "The Credentials of Science the Warrant of Faith," by Prof. Josiah Parsons Cooke; "Factors in American Civilization," a series of fourteen popular lectures before the Brooklyn Ethical Association; "The Personal Recollections of Werner von Siemens;" "The Development of Mind in the Child," by Professor W. Preyer, of the University of Jena, a new volume in the International Education Series.

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Wants.

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WANTED.—Assistant in Nautical Almanac office, Navy Department. The Civil Service Commission will hold an examination on August 15 to fill a vacancy in the position of assistant (computer) in the Nautical Almanac office. The subjects will be letter-writing, penmanship, trigonometry, rudiments of analytical geometry and calculus, logarithms, theory and practice of computations, and astronomy. Each applicant must provide himself with a five-place logarithmic table. The examination will be held in Washington, and if applications are filed in season, arrangements may be made for examinations in the large cities. Blanks will be furnished upon application to the Commission at Washington.

SCIENCE

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QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, SEPTEMBER 29, 1893.

THE MUTUAL RELATIONS OF SCIENCE AND STOCK BREEDING.*

BY WM. H. BREWER, NEW HAVEN, CONN.

THE production of crops and the production of animals are the two great branches of agriculture. The application of science to the production of crops has been more conspicuously before the public than to the production of animals, and agricultural science has devoted most attention to this branch of production. There could be no comprehensive science of agriculture until there was a science of chemistry, and the modern revolution in the art and practice of agriculture has come about as the science of chemistry advanced and mechanical invention progressed.

The application of scientific methods to the economic breeding of farm animals came much later and followed the publication of Darwin's "Origin of Species." Facts began to be systematically recorded for the construction of a science of breeding much earlier than that, but a collection of facts does not constitute a science, and breeding remained strictly an art until within the last few years.

As an art breeding attained a high standard long ago as respects the production of some fine examples of particular breeds. But except with Arabian horses, and possibly certain strains of game-fowls which were bred nearly pure, crossing was the universal method of improvement practised in all countries of European civilization. This led to wide variation and great uncertainty of product. The modern method of improvement within the breed, keeping the blood pure, has been the outcome of scientific study applied to the economic production of animals.

This knowledge was of slow growth and the practice was applied to the breeding of English race horses before it was to useful farm animals. The English race horse, or "Thoroughbred," is of composite origin, but originally mostly of Oriental stock. The pedigrees of the winners began to be printed before the middle of the last century, and after a time an annual list of the winning sires was published. It came to be recognized that the winners were, as a rule, of the purest blood, rather than crosses, and this led to improvement by selection within the breed itself rather than by crossing. Then pedigrees were gathered and collated and the first volume of the "Stud Book" was published in 1791. This gave the data necessary for a study of the ancestry of any given animal of that breed, but the method was not extended to the breeding of the other useful farm animals until long after, and more than thirty years elapsed before any other comprehensive registry of pedigrees was printed for public use. The "Shorthorn Herd Book" was published in 1822.

The forerunner of breeding by pedigree as now practised was breeding in-and-in, which came into use for farm animals the last quarter of the last century. This was the opposite extreme of the wide crossing, so widely practised, and Robert Bakewell was its greatest promotor. Beginning with a very few carefully selected animals, he grew his flocks and herds from them, breeding between the nearest of kin and thus restricting the ancestry as to numbers, but increasing enormously the potentiality and hereditary influence of certain superior animals. He practised with great skill and selected his breeding animals with rare sagacity. He wrought great improvement, refining the carcass, improving the form, and extending the change to early maturity, better quality of flesh and general improvement in useful qualities of the animals. He wrote nothing. Breeding was with him a secret art, practised with great skill and success. This art was, however, taught to certain of his pupils, of which the brothers Colling became famous as breeders of shorthorns. But there was no science recognized because the general laws were not understood. Even Colling introduced a cross into his herd, and breeders are still, after nearly a century, discussing the influence of that "Galloway cross" on the breed.

Most of the leading breeds of our farm animals existed after a fashion in the last century. The early history of nearly all of them is obscure, although much research has been expended in unraveling it. But, unless confined to some small island, as were the Jersey, Alderney and Guernsey cattle, the breeds were not kept pure, because the common method of improvement was by crossing with other blood. Uniformity could neither be secured nor maintained by such practice, and naturally all the economic results were highly uncertain.

Some animals of great excellence were produced, but they were the accidental result of the uncontrolled and uncontrollable variation incident to the methods of breeding then followed.

The twenty-five years during which Darwin was accumulating the material and digesting the facts for his "Origin of Species," were important ones in the history of the theory of breeding, and a number of pedigree records were begun publication. The doctrine of improvement by selection within the breed instead of crossing with other blood was becoming better and better known by the more successful breeders, and the economic results were becoming more and more certain.

But scientific naturalists, absorbed in the description of natural species, ignored man's artificial productions. A breed may be, and often is, as artificial a production as is a picture or a statue. The breeder, like the sculptor, must have his ideal towards which he is working, the greater his genius the nearer his creations come to reaching his ideal. The earlier naturalists, like Buffon and Cuvier, had studied and written about domestic animals as a part of nature, but their successors came to consider them artistic rather than natural productions, and to look upon these "artificial monstrosities" with a contempt not now appreciated by the younger generation of naturalists.

But the difficulties of the old system were well nigh crushing the life out of natural history, and the time was ripe for a new theory on the origin and nature of species.

*Synopsis of Address by Wm. H. Brewer, Vice President of Section I., American Association for the Advancement of Science, at Madison, Wisconsin, Aug. 17, 1893.

When Darwin brought us out of the difficulty it was largely by a study of the experience of breeders. This was analogous to the establishing of a new and vast biological laboratory for scientific experimentation and never before was such a profound change brought about in a dogma of science by a study of an economic art.

All the earlier stud books and herd books were prepared and published by private individuals as any other book might be produced by a compiler and author. Now they are mostly published by associations clothed with authority and having wider aims. They record and publish pedigree, define methods and conditions for establishing their authenticity, and fix the standards which dictate what the essential characters of the breeds shall be. Nearly every useful breed has now some such association, publishing an authorized stud book, herd book, flock book, or register of some kind; the total number of such works aggregates hundreds if not thousands of volumes.

It is in fancy breeding that the most wonderful results are produced and some of the most instructive facts are found. The economic factor is here often entirely eliminated, and mere whim or fancy guides the experiments. Fanciers had their associations and set their standards long before the breeders of the more useful farm animals did, and to that Darwin turned his attention. He joined various pigeon societies, put up his cotes, became a practical and experimental fancier and mingled with his fellow fanciers, drawing on their rich stock of knowledge and experience.

A result of all this has been a better knowledge of the laws of heredity and of the causes which promote variation. A science of breeding now underlies the practical art. A pure science is relatively exact in the proportion in which it enables us to predict events, its economic applications are valuable in the proportion in which it enables us to control results. The breeder of to-day controls results with a success his ancestors never dreamed of.

The practical result is that the economic production of animals is now placed on a very much surer foundation, excellence is made more uniform, the chances for failure are enormously lessened and the methods of improvement placed on a philosophical basis.

The gain to science has been correspondingly great and numerous unsolved problems in biological science find here their material for use. Economical and social science, also, here find a field for experiment and deduction. Science will therefore be the gainer in the future as truly as in the past.

NOTE ON THE BURIED DRAINAGE SYSTEM OF THE UPPER OHIO.

BY RICHARD R. HICE, BEAVER, PA.

In reading the discussion of the buried river channels in western Pennsylvania, by Professor J. C. White,* the impression is left with the reader that none of the tributaries of the Ohio and Big Beaver rivers have buried channels, but that all are flowing over undoubted rock bottoms, at, or within a short distance of, their mouths.

At the time Professor White examined this district, (1876) there was, in some cases, apparently ground for this belief, though a careful examination of other streams would have thrown much doubt on the correctness of this conclusion. Recent developments, however, have demonstrated in some cases that buried channels exist, and the nature of the surroundings in other cases, render the conclusion that the apparent rock bottom is real, a mistake.

Passing up the Ohio and Beaver from the Ohio State line, we first reach the Little Beaver. A short distance from its mouth we apparently find a rock bottom as described by Professor White,† but in building the abutments of a bridge near this same point, a depth of fifty feet was reached without finding rock. A depth that closely corresponds with that of the Ohio, which here lies on the southern side of the present valley. Near Cannelton, also, a number of miles up the valley of the Little Beaver, a well has been recently driven fifty feet through gravel without finding rock and abandoned.

Raccoon Creek, coming into the Ohio from the south, flows at its mouth through a narrow rock gorge, but below the present mouth there is a gravel terrace for about a half mile, and there is ample room for a buried channel. Passing up this stream there does not seem to be a rock bottom, except at its mouth, for several miles. The present channel makes a sharp turn up the Ohio at its mouth, while the gravel terrace, reaching on its river front at least to low water, lies in the direct course of the creek, and reaches back to the point where the course of the creek changes.

Two Mile Run, a comparatively small stream, flows through a narrow gorge in the ferriferous limestone, for about a quarter of a mile above its mouth, but passing above this gorge, it flows over a gravel bottom, parallel with the Ohio, for about a mile, at which point it leaves the valley, and enters a narrow gorge, in which no rock is found in the bed of the run for about two miles. The direct course from the narrow gorge to the Ohio, is blocked by a gravel terrace, which reaches below the present river level.

Passing up the Beaver, we first reach Brady's Run. This stream, at its mouth, also runs over a rock bottom; but, in the erection of a bridge at its mouth, it was discovered that the present channel lies immediately beside a buried one, the rock dropping off precipitously, and a well one-half mile up the stream has been driven fifty feet to rock, in a location that does not seem to be the middle of the buried channel. This well is at a point where the bounding hills rise 100 feet plus and 350 feet plus, respectively.

Connoquenessing Creek, for the four lower miles of its course, flows in a narrow rock gorge, and at one point, about one-fourth mile from its mouth, it is now flowing over a rock bottom. Above this gorge, the stream flows in a much older valley, with no indication of a rock bottom. As yet no outlet has been found for this stream into the buried channel of the Beaver, but the thick covering of morainic material makes any examination very uncertain in its negative results.

These are the principal streams, and the evidence, though not yet conclusive in all cases, clearly shows that no reliance can be placed on an apparent rock bottom at or near the mouth of the stream; indeed the Beaver itself flows over a rock bottom within two hundred yards of its mouth, as well as at three other points within less than five miles of its mouth, yet no stream has a better defined buried channel; and also shows that the time of the erosion of the buried channel was not so short as some have claimed on the supposed evidence of the absence of buried channels of the tributary streams, but was long enough to admit of the erosion not only of the main lines of drainage, but of many of the tributary channels as well.

Messrs. P. Blakiston, Son & Co. announce that Dr. George M. Gould, already well known as the editor of two small medical dictionaries, has now about ready an unabridged, exhaustive work of the same class, upon which he and a corps of assistants have been engaged for several years.

*Second Geol. Survey Penna. Vols. 2, 22.

†2, page 16.

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CORN CANE.*

BY F. L. STEWART, MURRYSVILLE, PA.

THE numerous varieties of maize now grown throughout the United States may conveniently be divided into a few general groups, easily distinguishable by the form and qualities of the grain.†

The most prominent of these are the Dents (white and yellow), Flint, Popcorn and the so-called sweet varieties. Since all sorts, however unlike otherwise, conform to the principle that the arrested development of the seed at the period above indicated, produces sugar accumulation in the cells of the stalk, and since it has been found that the sugar percentage is about the same in all at corresponding periods, it follows that the choice of the sugar planter, among the different kinds, must rest upon the most vigorous and well developed of the large-stemmed varieties that will mature their juice in any given locality. The people of our more northern States make a mistake in regarding the hard-glazed or "Flint" varieties of field corn, which are largely grown in that climate, as the best types of the species, naturally, and as bearing the best commercial type of the grain. Our western growers have already established a different standard, one which obtains now for American corn throughout the world and comes almost exclusively from the "Dent" group.

The best representatives of the species, both as regards vigorous growth and the nutritive qualities of the grain, are undoubtedly the large southern varieties, white and yellow. Maize is naturally a sub-tropical plant, but being an annual, ripening within a single season, our peculiar summer climate enables us to grow it to perfection under directly sub-tropical conditions; and in proportion as the Dent corn of the west and southwest approaches the southern type more closely in luxuriance of growth and the softer quality of the grain, does it increase in productiveness and nutritive value.

Among the different races of corn now existing the matured grain varies wonderfully, both in external qualities and composition, ranging from the "sweet" corn, with its permanently soft grain, richly charged with readily soluble food materials, on the one hand, to the "Flint" corn of New England on the other, yet the ear of the latter, in its immature stage, is but slightly different in composition and quality from that of the immature sweet corn.

It is not a little remarkable that this period of arrested development is the only period when the grain of all varieties may be said to have a common character. Experiments in stock feeding, as well as analytical results, show that it is then also in its most availably nutritious condition.

This stage now proves, also, to be a turning point in the life and economic use of the individual plant, when an alternative is significantly presented to the choice of the grower. The prompt separation of the ear at this stage conditions the full development of the sugar and the prolonged existence of the plant. But if the grain be allowed to glaze nothing can avert the almost immediate death of the plant and, excepting the seed, the destruction of the whole organized structure.

In the former case the result is equally certain and absolute. The saccharine development may be depended upon to go on until it has reached its limit, and it is as fixed and constant an attribute of the whole species as it is in the maturing joints of the sugar cane itself.

It remains for me only to indicate, in the briefest way possible, what is necessary now, practically, to make sugar manufacture a success from this new source.

First in importance is the answer to the question what varieties to plant that are best for this use. No one sort can be named which is equally well adapted for all localities, even in the main central corn belt of the United States. Everywhere in that region the period of juice-ripening is naturally brought to an end only by the frosts. Corn cane is nearly as sensitive to severe cold as the sugar cane, and throughout that region generally the aim should be to plant such varieties as will develop the milky condition of the grain by the 20th of August, so as to insure a period of two weeks for sugar accumulation by the first week in September, when the manufacturing season for the main crop would regularly begin. The following well-known sorts sufficiently matured their juice last season early in September, and most of them can be recommended for this use from Ohio westward and southward, ranking them in that region in the order named:

1. Large Southern White or Virginia fodder corn.
2. Burpee's Golden Beauty, a highly improved and well established variety of the yellow Dent.
3. Chester County Mammoth.
4. Kansas Yellow Dent.
5. Early Mastodon Dent.

The first named is the best ensilage corn grown, and wherever it will mature its ears to the roasting ear condition in August it will have the preference in sugar manufacture on account of its great productiveness and the richness of its juice. Golden Beauty has been tested from the outset of these experiments in 1884, and with the very best results. Like all the rest named, its stems are very robust, well developed stalks when trimmed weighing three pounds.

After these, but not ranking with them at all in productiveness, Stowell's Evergreen-Egyptian and Mammoth Sugar, among the sweet corn group, may be named. Their juice is not superior to that of field corn in any quality. I have no question that by selection and inter-crossing a variety of sweet corn will yet be produced which will be as productive of grain for canners' use as any that we now have and equal to the field varieties in robust stem-growth. For the sugar crop, no special preparation of the soil is needed other than is commonly required to produce a heavy crop of field corn. The seed should be sown in drills three and a half or four feet apart, and thickly enough for the plants to stand about ten inches apart in the row.

*Continued from Science, Sept. 22.

†Dr. E. L. Sturtevant, while in charge of the New York Experiment Station, corrected the nomenclature of maize and originated a system of classification, deriving the distinctive characters from peculiarities in the structure of the kernel or grain. The arrangement seems to be a natural one otherwise, and his definitions of the varieties then existing are very valuable now for purposes of identification, although some new ones have originated since then. (N. Y. State Expt. Reports for 1883 and 1884.)

Experiment has proved that a yield of fifteen tons per acre of trimmed cane from the large southern corn is, under these circumstances, an average result.†

The use of bone phosphate, and especially nitrate of potash, applied in the hill as fertilizers, is strongly to be recommended. Also, the best labor-saving implements should be employed in the cultivation of the crop. These have so far proved their value as to have reduced the cost of corn-growing within the past twenty years by about fifty per cent.

The ear should be allowed to develop until the grain has reached the "milky" stage, but never in the least beyond it, and when field corn is grown, first the ears in the husk, and subsequently when the stalk is cut, the tops, leaves and other offal should be passed through an ensilage cutter and treated precisely as ordinary ensilage. Or, when special facilities have been provided for it, the grain on the cob, with the husk removed or not, may be kept apart by itself, and after being coarsely crushed, or cut into small pieces, may be fed in that condition or dried and ground as feed for stock. In this form it is much superior for cattle food to the ordinary corn and cob meal.

To facilitate the removal of the ears the corn field, when planted, may be laid out in lands or sections of about eight rows in each, with an interval of about five feet between the outside rows of adjoining sections, so as to admit of the passage of a short-axled cart drawn by a single horse or two in tandem to carry off the grain. This will be done, and the ears in the husk properly cut and stored in the silo, or dried and ground, before the sugar season has properly begun.

At this time it is important that every vestige of an ear should be removed from the stalk; and, thenceforward until they are cut to avoid injury from frost, every day adds to the accumulation of sugar in the cells of the standing canes. But in climates where the growing season is short, or, as sometimes occurs further south, unusual cold sets in early in the fall, it is better to avoid the risk of injury to the crop by harvesting it about two weeks after the removal of the ears, when the juice will have attained a density of about 8° Beaumé, containing about thirteen per cent of cane sugar.

†Trustworthy evidence that this yield of corn cane per acre from the large-stemmed sorts is below the average is furnished in the reports from the different State Agricultural Experiment stations of the yield for ensilage when accurately weighed. Up to the period at which it is usually cut for that purpose, the conditions of growth are essentially the same as when sugar-growing is the ultimate object.

At that stage an average of about twenty-five per cent must be deducted from the gross weight of green ensilage for the weight of the immature ears, blades and tips. The remainder is to be estimated as trimmed cane.

Some examples are given below of the yield in districts well known to be less favorable for the growth of the large, late sorts than the more central parts of the corn belt.

Yield per acre:

43,700 lbs. (21.85 tons) southern "Ensilage" corn, 42,060 lbs. (21 tons) southern "Horse Tooth."—Prof. W. A. Henry, Wisconsin Ex. Sta. Report, 1891.

50-60 tons "Southern Fodder Corn," 32 tons "Mammoth," 30 tons "Southern Horse Tooth," Native Yellow Flint, only 15-20 tons.—New Jersey State Expt. Sta. Rep., 1881.

27.37 tons "Orange Flint."—N. Y. Ex. St. Rep., 1885.

40 tons "Southern" corn and "Blount's Prolific."—J. J. H. Gregory, Marblehead, Mass.

29 tons "Southern" corn.—T. S. Peer, Palmyra, N. Y.

30 " " " J. J. Chaffie, Passaic, N. Y.

27.5 tons "Blount's Prolific."—F. E. Loud, Weymouth, Mass.

46 tons or 600 tons on 13 acres.—Clark W. Mills, Pompton, N. J.

50 tons "Kentucky White."—Geo. L. Clemence, Southbridge, Mass.; quot. H. J. Stevens on ensilage.

25 tons per acre on 15 acres.—F. R. Coit, Mantua Sta., O.

20 to 25 tons "Penna. Dent."—Ralston Bros., Elderton, Pa.

If properly stored so as to be screened from the sun and rain in a cool place, the canes can be worked up within about ten days after cutting without appreciable loss. But if warm weather prevails, the interval should be as short as possible between the time of cutting and working up.

The internal structure of the corn stem is peculiar, so much so as to make the extraction of the juice from the canes by the ordinary sugar mill practically impossible. These structural peculiarities, as disclosed by the microscope and as evidenced by numerous practical tests for the extraction of the juice, make it plain that other means must be resorted to than pressure between revolving rolls to extract the cell sap.

Corn cane yields to pressure much more readily than the sugar cane or sorghum, but the elasticity of its tissues is such and the recovery so sudden after passing the line of pressure that fully one-half of the expressed juice is mopped up before it can leave the roll or the guide plate and is re-absorbed.

No other plant is capable of being exhausted of its cell contents more rapidly or thoroughly by diffusion; but the expense of that process is very considerable and its inconvenience very great. It was seen that the economy and efficiency of any system of sugar making from this plant must depend largely upon the construction of a machine which would separate the juice expeditiously and without waste. It was at last found that a sufficiently simple apparatus could be constructed by which the benefits of both milling and diffusion could be secured without any of the prominent defects of either system when separate. Special mention is made here of these facts for the reason that the only practical difficulty peculiar to this plant, in the extraction of its sugar, is thus easily overcome.

Sugar making from this or any other plant is both a science and an art, and the general principles upon which it depends are now well understood. The composition of the juice of corn cane is somewhat peculiar,‡ but not sufficiently so as to require any considerable deviation from the best systems of sugar manufacture now in vogue for the treatment of the raw juice of the tropical cane.

I conclude this sketch with a brief summary of the results reached, leaving the intelligent reader to draw his own conclusions. But it must be said, that if we would now reach any just estimate of the saccharine value of maize, in this new role, we must remember that all previous attempts to determine it were made without any knowledge of the important physiological principle upon which that value solely depends and which this investigation has now disclosed.

From a system of treatment which takes advantage of this in a practical way it follows:

1. That the highest normal of sucrose or true cane sugar in the juice, seven to eight per cent, is raised to thirteen to sixteen per cent, or almost doubled.

2. This is accomplished by a true juice-ripening process, analogous in all respects to that which marks the maturing sugar cane. It is natural to the plant under the changed conditions and is constant in all varieties of the species.

3. Its rank as a sugar-producing plant, under these circumstances, having thus been accurately determined, and a wide range of experiments undertaken to test the practicability of sugar extraction having proved that no hindrances thereto exist that are at all comparable to those met with in the case either of the sugar beet or of

‡Corn cane juice contains an organic acid previously detected only in corn silk (maizenic acid). A peculiar protein body Zein long ago found in the grain, is also found in the juice, together with several others not thoroughly investigated.

sorghum, the chemical constitution of its juice approaching more closely that of the tropical sugar cane than any other, the term *corn cane* here used to distinguish the plant when in this condition of development will, I trust, not seem to be misapplied.

4. The utilization of the plant in this way is the most thorough and perfect possible, because it takes advantage of the fact that the development may be so controlled as to secure from the same individual plant at two different periods of its existence: first, the grain product, when in its most nutritive and assimilative condition to serve as feed for animals, or as bread food, and second, and conditioned upon the first, a matured condition of the highly organized substances in the cells of the living stalk, and their safe storage there for an indefinite time, a full crop of sugar being thus easily attainable as the result.

5. No risk is run by the grower in producing corn cane, because it is at his option, up to an advanced stage of its growth, to choose whether he shall harvest it as a grain and sugar crop combined, or as ensilage simply, or as the ordinary product, the hard ripe grain.

6. To secure a healthy and luxuriant growth and a full crop of any of these products the requirements as to climate, soil, tillage, the use of fertilizers, etc., during the true growing period, are almost precisely the same in all cases. No new system of agriculture is necessary to be inaugurated to make sugar-growing at a profit a success, no new plant is to be acclimatized before its merits can be tested, but following a system of culture with which we are familiar, making one simple but radical change only in the routine, we have practically a new plant in the new uses that it serves.

7. It follows from this that the cost of sugar-growing from this new source, ought to fall much below the average cost of producing it from any other plant. This is still more evident if we consider that the sugar crop from corn is capable of being brought to full maturity in a relatively short period, as compared with either that from the sugar cane or the beet; that a ton of trimmed corn-cane, bearing at least as high a sugar percentage as the sugar beet, can be grown here at about one-half the cost of a ton of beets, not counting the immature grain and fodder ensilage produced along with it. The latter represents an added value almost equal to that of the sugar for which the sugar cane furnishes no equivalent whatever, and neither the beet nor sorghum any that will bear favorable comparison with it.

8. The enrichment of the juice of the corn plant grown for ensilage alone, or for use as dried fodder, secured by the timely removal of the ears and the curing of that part of the crop separately, is of scarcely less general importance than when sugar-growing is the main object.

9. It is evident, also, that the full limit of this enrichment has not yet been reached. The capacity of Indian corn, for rapid improvement through judicious selection and hybridization, gives promise of securing new races possessing still more valuable qualities for sugar production than are found in any now existing.

10. Among the benefits which the establishment of the sugar industry from maize will confer upon American agriculture, a prominent one will be to check over production of the hard-ripened grain. When it is known that from the same plant equally valuable products in other forms are regularly attainable, which, being substituted for the ordinary staple, will secure the benefits of a wholesome limitation to the production of the latter, the area devoted to the growing of the plant will profitably be enlarged to any extent to meet the enormous capacity of our western soils to produce it.

In giving to the public these conclusions it is, perhaps, scarcely necessary to add that the motive of this investigation was simply to fix the value of maize, under the new conditions, as a sugar-producing plant.

Table:—Relative composition of the juice of "corn cane" and sugar cane.

	Indian Corn.								East India Sugar Cane.* Carefully sampled good average cane. Aska Dist., Madras. (Gill.)			Louisiana Sugar Cane.† Magnolia Plantation. (Wiley.)			
	Period of Early Growth.				Period of Saccharine Development.										
					"Southern Fodder."		Penna Yellow Dent.	Golden Beauty.				Mean of 4 years.			
	In Tassel.	In Silk.	In early roasting ear.	Ear removed.	One month after removal of ear.			54 days after ear removed.	2 feet of top.	2 feet middle.	2 feet next root.	1884.	1885.	1886.	1887.
Specific gravity	1012.6	1034	1048	1056	10674	1071	10692	10694							
Cane sugar	0.	2.90	6.70	10.32	13.90	14.94	14.68	14.63	11.51	14.55	14.58	13.05	12.11	13.50	13.69
Glucose	1.87	3.00	2.50	1.90	1.61	1.16	1.08	1.04	2.86	1.65	1.68	0.67	1.02	0.61	0.77
Organic matter not sugar, and ash.	1.13	2.80	1.80	1.18	0.91	1.20	1.14	1.25	0.83	1.20	0.74	2.82	2.67	2.09	1.81
Total solids	3.00	8.70	11.00	13.40	16.42	17.30	16.90	16.92	15.20	17.40	17.00	16.54	15.80	16.20	16.27
Water	97.00	91.30	89.00	86.60	83.58	82.70	83.10	83.08	84.80	82.60	83.00	83.46	84.20	83.80	83.73

*Gill's analysis, quoted from Allen's Organic Analysis, Vol. 1, p. 261. (1885.)
†U. S. Department of Agriculture, Bulletin 18.—Wiley. (1888.)

Disparagement of the earnest efforts that have for many years been made, and are still being made, to make beet sugar growing in this country successful, has not been thought of. But it must be remembered that every industry dependent upon plant growth and development for its existence must have due respect to the peculiar conditions of climate and soil prevailing in the country where it is proposed to establish it. It is now well known that the climatic limits of successful maize-growing on this continent are very wide, and those restricting the beet for employment in sugar manufacture are quite narrow. Here, as elsewhere, the foundations of success are laid in natural laws. And one thing seems clear: the typical sugar plant for America must be one possessing the robust health and all the qualities which are supposed to spring from being "native and to the manor born," and which, while meriting and needing, perhaps, the fostering care of the home government as the basis of a new industry, at the start, yet must prove its ability to stand alone, unsupported by a bounty or any other merely adventitious aid.

THE METEOROLOGICAL CONGRESS.*

MONDAY, August 21st, at ten A. M. the congresses of the Department of Science and Philosophy of the Congress Auxiliary of the Columbian Exposition were formally opened at the Memorial Art Institute of Chicago with an address of welcome by the President, Mr. C. C. Bonney, followed by responses from representatives of the various special congresses. At the close of this general session the different divisions met in rooms assigned to them, the Division of Meteorology, Climatology and Terrestrial Magnetism meeting in room XXXI, in which the regular sessions were held daily from 10 A. M. to 2 P. M. from August 21st to August 24th.

The chairman of the Congress not being able to be present in person the first day, Prof. F. H. Bigelow, representing Prof. Mark W. Harrington, opened the session at eleven A. M. of the 21st with a few words of welcome and a statement of the objects of the Congress.

The Congress had no legislative authority. The main purpose, as previously announced, was to collect together a series of memoirs "outlining the progress and summarizing the present state of our knowledge of the subjects treated," and to print them in full in the English language.

The meetings, while thus making the reading and discussion of papers a matter of secondary importance, were by no means lacking in interest or profit to those who were present. But few of the papers could be read in full, owing to their great number and the absence of many of the authors. In all about 130 papers were read by title, in abstract or in full, forming a most valuable collection of memoirs prepared by writers of authority in their respective lines of research.

Among so many papers of merit, a simple list of which would occupy several pages, individual mention cannot be fairly attempted.

While the papers were read in general session, they were assigned, in the program, to various sections, according to the subject, each section being placed in charge of a responsible chairman.

Section A. Prof. C. A. Schott, U. S. Coast Survey, and Mr. H. H. Clayton, U. S. Weather Bureau, Chairmen. The papers of this section are devoted to instruments, their history and relative merits, and to methods of observation, especially to methods of observing in the upper air.

Section B. Prof. Cleveland Abbe, U. S. Weather Bureau, Chairman. This section is the most extensive in its scope, dealing mostly with questions in dynamic meteorology; much attention is given to the study of thunderstorm phenomena in various countries.

Section C. Prof. F. E. Nipher, Washington University, Chairman, comprises a series of sketches of the climate of different portions of the globe.

Section D. Major H. H. C. Dunwoody, U. S. Army, Chairman, is devoted to the discussion of the relation of the various climatic elements to plant and animal life.

Section E. Lieut. W. H. Beehler, U. S. Hydrographic Office, Chairman, deals with questions relating to marine meteorology, particularly to ocean storms and their prediction, methods of observation at sea, and international co-operation. During the reading of a paper on the work of the Hydrographic Office of the Navy, Lieut. Beehler had on exhibition a fine bust of Lieut. Maury by the sculptor Valentine, of Richmond, Va.

Section F. Prof. Charles Carpmael, Director of the Canadian Meteorological Service, and Mr. A. Lawrence Rotch, Director of the Blue Hill Observatory, Chairmen, comprises papers relating to the improvement of weather services and especially to the progress of weather forecasting.

Section G. Prof. F. H. Bigelow, U. S. Weather Bureau, Chairman, deals with problems of atmospheric electricity and terrestrial magnetism and their cosmical relations.

Section H. Prof. Thomas Russell, of the U. S. Lake Survey, Chairman, has to do with rivers and the prediction of floods.

Section I. Oliver L. Fassig, Librarian U. S. Weather Bureau, Chairman, is devoted to historical papers and to bibliography, with special reference to the history of meteorology in the United States.

Prof. Mark W. Harrington, Prof. F. H. Bigelow, Capt. P. Pinheiro, of Rio Janeiro, and Lieut. W. H. Beehler successively presided over the meetings. The printed program distributed at sessions of the Congress contains a list of all papers presented; copies of this may be obtained from the Secretary upon application.

At the close of the last session a resolution was offered calling for recommendations by the Congress relating to (*a*) international co-operation in observations of auroras, (*b*) simultaneous Greenwich noon observations daily at all stations on land and sea, in addition to observations at other times, (*c*) investigation of the earth's magnetic polar current and the exact determination of the solar rotation. As the Congress had no legislative authority, it was agreed to hold a special session for the consideration of these questions after adjournment, on the following day.

Preparations have been begun for the printing of the papers and an effort will be made to complete the work at an early date. Oliver L. Fassig, U. S. Weather Bureau, Washington, D. C., is the Secretary.

*Held at Chicago, August 21st to August 24th, 1893.

SALT TIDE MARSHES OF SOUTH JERSEY.

BY JOHN GIFFORD, SWARTHMORE COLLEGE, PA.

THE mainland of the peninsula of South Jersey is fringed by many miles of marsh meadow. At times this level plain is completely covered by water. It consists of a mass of soft blue-black, bad-smelling mud, covered with a thick sod of grasses, rushes and sedges, and intersected by many winding, reed-fringed creeks, shallow bays, salt ponds and thoroughfares.

These marshes are separated from the ocean by a long line of low, sandy sea-islands, between which there are inlets through which the tides flow swiftly.

This stretch of marshland is of very recent origin. During Indian times it was probably a shallow sea. This accounts, perhaps, for the enormous quantities of clams and oysters which then existed. The majority of the bays in the marshes are very shallow and may, also, in the course of time, become unfit for oysters.

The rivers of South Jersey holding fine sand in suspension flowed into an ocean where there was practically no current. This material was then, in consequence, deposited, and there was thus formed a long sub-marine bank. This tripped the waves into breakers, which lifted the sand into a long line of low sea-islands.

The combined estuaries of these rivers formed a long, shallow inland sea, in which, owing to the slackening and meeting of currents, enormous quantities of silt were deposited. Wild water-fowl and winds disseminated the seeds of grasses and sedges on the mud bars, which were soon formed. The decay of each year's vegetation and the scum of mud left by every tide caused a gradual thickening of the sod. Three hundred thousand acres of marsh region have thus been recently formed.

Being an estuary, the scouring force of the tides prevents the formation of extensive beaches on the bay-side of Jersey. The sand is held in suspension until the current is slackened by striking the ocean where a shoal is forming.

Since the formation of these marshes the beaches, by the action of wind and wave, have been moving inland. Inlets are becoming shallower, and the beaches, in places, have been completely blown from their original bed over on to the marshes, so that the marsh mud is often exposed on the ocean side.

This accounts for the size which the trees attain in these places. Many beaches support only a shrubby vegetation, others are covered with beautiful forests of trees of surprising size. Red cedar, holly, sassafras, oak, liquid amber, sour gum, magnolia, sweetgale and grape vines grow to be unusually large. Some of the finest specimens of holly in existence may be found on several of these beaches, and the red cedar which grows there is more durable than that of the mainland. The size of these trees is due to the fact that their roots have penetrated through the sand of the beach into the rich, black mud of the marsh beneath.

These forests are doomed. The wind picks up the fine white sand of the beach and piles it in dunes. These are often as high as the tree tops and are moving gradually inland, leaving only a mass of dark gray trunks behind. Unfortunately the trees themselves prevent the west and and north winds from blowing back the sand.

The fact that Jersey is slowly sinking complicates these changes. The marshes, in consequence, are intruding upon the mainland. Even white cedars, which only grow in pure fresh water, have been found buried in the marsh. Little islands and Indian shell heaps are slowly disappearing.

In the formation of these marshes organic agencies play an important part. An examination of the mud in shallow bays and salt ponds shows enormous quantities of beautiful diatoms. There, too, are many kinds of shells. Other animals, especially those of the crab tribe, completely honeycomb the marsh in places.

These meadows are very rich and valuable for farming. When banked and sluiced, although they shrink, they freshen and, after being worked for a time, yield enormous crops. In several places in South Jersey they have been converted into flourishing farms. In other places up the rivers they have been abandoned because of the muskrats which undermine the banks.

These vast stretches of marsh are richly colored, and at times, in places, are covered with white, pink and yellow flowers. They are alive, in season, with wild migratory water-fowl, infested with flies and mosquitoes and flecked with the sails of boats moving in the creeks and bays. In winter they are deserted and dreary, the monotony of which is only broken by a hay or fish house here and there or the remnants of a stranded schooner.

The collecting of the hay which grows on the marshes is one of the leading industries of that part of the state. It is still, in many places, cut with the scythe and carried on hand poles to large clumsy scows, which are rowed with two long oars to the landings.

There are 300,000 acres of marsh region in South Jersey. At least one-twentieth of this is cut for hay. An acre yields, without sowing or care, other than a little ditching, at times, and burning once a year, at least one and a half tons. The many creeks which bend in every direction render it easy of access. It is worth at least six dollars a ton. The annual crop is worth then not a cent less than $135,000.

The marshes are often too soft for horses; in places they are provided with wooden shoes, and many meadows are hard enough for the use of machines.

This hay is often baled and shipped away. The greater part is consumed at home. Poor qualities are used by glass factories for packing purposes.

The two plants of greatest value yielding hay on these marshes are *Spartina juncea* or "salt-hay" and *Juncus gerardi* or "black-grass." The one is a true grass, the other a rush. The salt hay is light in color, contains few seeds, is cut late in summer and is fed to horses. The black grass grows in brackish regions, is full of seeds, is dark in color, is cut in mid-summer and is fed to cattle.

If reclaimed on a very large scale, as in Louisiana, the writer believes that these marshes may and will soon be converted into flourishing farms.

METHODS OF PRESENTING GEOLOGY IN OUR SCHOOLS AND COLLEGES.*

BY MISS MARY E. HOLMES, PH.D., ROCKFORD, ILL.

Before offering any suggestions as to "methods" of presenting this study, let us state a few axioms:

First. For the successful study of any subject there must be some foundation.

Second. Comparatively few of our high school pupils enter college.

Third. The large majority of school age will not advance beyond the grammar grade.

Fourth. The impressions earliest made are most enduring.

Fifth. If we would make geology a life force, a life inspiration to the masses generally and to those in our high schools and colleges, we must begin with the little children.

How early a child's attention may be profitably called to the elements of geology may be questioned, but I think as soon as he can talk, and understand what is said to him. Of course the first lessons will be very, very simple—mostly in *form* and *color*. He will gladly gather for you the "pitty stones," and you will notice that these, gathered *by himself*, and when *alone*, are generally either definitely colored, or smooth rounded ones, or smooth flattened ones, few being angular. With your aid let him separate the rounded from flattened, calling his attention to the difference in *shape*. Mix them and separate again. Repeat the process many times, at first always letting the child *hand you* the stones, you frequently asking: "Where shall we place this one?" Later, let him place them himself. In a few days he will have so mastered the distinction between *flat* and *round*, that he can separate quite correctly a large pile. Never continue the lessons till he is weary. When such signs appear suggest that he run out doors and play. In all probability he will return with another pocketful of stones. Appear pleased with his acquisitions and *be* pleased. He will detect any insincerity. Give him a box, or a low shelf of his *very own* for his treasures. With encouraging words, the child will thus spend many hours; they are not play, nor work, but happy, instructive seasons.

Having learned to separate round from flattened stones, call his attention to rough, *angular* forms. He will quickly note the difference. Show him that these are *angular* because *broken* from a larger stone. Illustrate by some broken toy of his own. Also show him how to make more angular ones by cracking these with a hammer. If he pounds his fingers, a little experience will remedy that as a frequent future result. He cannot appreciate the smoothing effect of water, so pass it by. Many lessons upon surfaces may be received unconsciously in this way, the child learning how to use his eyes, and to compare one object with another.

Next, take the *colors* of the stones. Separate them into piles, *dark* and *light*. Separate again the blackish, the red-

*A paper read before the Woman's Department in Geology in the World's Congress Auxiliary of the World's Columbian Exposition at Chicago, August 21, 1892.

dish, the gray and the white. Do it with him many times, but each time he will do it more and more himself, till he accomplishes it alone. Should any pebble have a *hole* in it, or any special feature, his eye and finger will be sure to find it, and an exclamation will burst forth: "See!" He has *discovered* something. He now looks for more, like, or similar to it.

Next, teach him to select them according to *lustre*, if in a vicinity where micaceous or other specially lustrous rocks are frequent. If not, as a special privilege, let him *wet* some in a *bowl of water* while the others are dry. The difference he quickly sees, and next time, if no water is at hand, he will be more than apt to wet them with his tongue, and exclaim again "See!" his tone and look indicating that he *recognizes* an effect upon the stone like that produced before by the water. Here he has really learned that one general agent, under two forms, from two different sources may produce a similar effect. As to kinds of lustre, he may be readily trained to recognize *pearly*, like the inside of the shell on the mantel, and *glassy;* also that the *absence* of lustre is *dull*. Of *degrees*, he can comprehend *shining* and *glistening*, and learn the words as well. A child does not need such short words as we often think. He delights in mastering a "big word," if only for the protracted sound, but if it conveys a pleasant thought, his interest is greatly intensified.

Next, teach *hardness* by rubbing two stones together, and by letting him try to scratch them; first with a *nail*, and second with a sharp-edged piece of *quartz* or *flint*. He can make perhaps three piles—those *soft*, easily scratched with anything; those *harder*, only scratched with the nail and quartz, and those *hardest*, not scratched by the nail, but by the quartz. These distinctions are crude, but real, to the child that recognizes them.

What has been thus pursued from day to day in the realm of stones, if the mother or kindergartner is wise, should have been carried on also with plants, insects, and birds, even some lessons on the "twinkling stars." Of these, botany, zoölogy, and astronomy, we do not now speak, but, be it remembered, that no single science at once bears as strong a relation to, and is so dependent upon, a knowledge of botany, biology, chemistry, mineralogy, physics and astronomy, as is geology. It emphatically furnishes a foundation for them, and in turn must look to them for the interpretation of its data.

By the time a child is of ordinary school age, under such a course of observation, comparison and generalization as the foregoing would suggest, he has formed a *habit* of being *interested* in *everything about him*. If he is a city child, he can have learned all here outlined, or its equivalent; and if a country child, even more, for *he* is constantly in direct communication with Nature's open album of new and beautiful objects for observation and subjects for reflection.

Continuing our study of stones, we will try the action of *water* as a *solvent*. The teacher should place in the pupil's way some varieties, as rock salt, or a hard lump of common salt, which are *quickly soluble*, alum, *not* as *quickly;* a rusty nail that will color the water in a few hours, and the child's own quartz pebbles, *insoluble*. Call attention to the different actions. With the salt a lesson on *saturated solutions* may be given. Having shown the effect of water, try *acids*—strong vinegar or hydrochloric acid—upon various stones. Some are unaffected, some hiss a little, some boil violently. Can you *see* anything passing off? No. Can you *hear* anything? Yes; there is a bubbling. What *do* you *see?* The bursting of the bubbles. Why do they burst? An *invisible gas* is passing off. Have you ever seen anything else boil *like that* in a *bottle* or a *glass?* Some pupil will suggest "*beer*" or "*soda-water*." Yes, and the same cause produces both; this unseen gas we call *carbonic acid gas*. Let the pupils taste a little cooled, boiled water, and some fresh, hard, well water. One tastes *flat*, the other *good*. The same thing that escaped from the stone, beer and soda water, gives, in the main, the difference of taste between these two waters, viz.: *carbonic acid gas*. Try more stones with the acid. Some hiss, some do not. All that *do*, have *this gas* in them, and are called *carbonates*. Try the acid again on a *carbonate*. It boils; continue pouring it slowly till boiling ceases. Note the effect; the stone has turned to *sand-like particles*. Take another carbonate, pour on acid; it boils. After a moment pour on some *aqua ammonia*, the boiling ceases; pour on more, the stone does *not* crumble. Take a third carbonate; pour on ammonia only. There is *no* apparent effect. In the first case the stone crumbled; in the second, the crumbling was checked, and in the third, there was no change. Evidently something *holds* the *grains together*. What? Some child will say "that gas that blew away." What is it called? What are all such stones called? Drill on this thoroughly. Illustrate solubility and carbonates also by baking soda and cream of tartar. Dissolve a little of each in tumblers of water. Let the pupils taste both in the dry powder. One, soda, is a *brackish sweet;* the other, tartar, is a definite *sour*. Pour part of the soda solution into the tartar tumbler; boiling or *effervescence* is instantaneous. Taste the tartar water now. *Almost sweet?* What has been given off to produce this change? Pour the rest of the soda into some *sour milk*. It, too, effervesces. Taste it. It is *sweetened*. The sour substances are *acids*. This element that sweetens them is an *alkali*. Ammonia is another alkali. Most alkalies are *odorless*, and all, if strong, will burn the skin severely. So children should never taste nor play with things in bottles without permission. Give some tiny experiments with *heat*. Throw several stones into a hot fire. Perhaps some *swell up*, some grow *porous quite rapidly*, others *more slowly*, and some are *unchanged*. Some change color, and some discolor the flame nearest them—making it *yellower*. Tell the pupils the explanation of this will come later, but because heat *does* this sometimes, it is used as a *test*. As far as possible, always use the children's own stones, and let them, in sections, do the work *after you*. There will be a little rivalry as to which can do it best and quickest. They will not weary though they see the same thing performed many times. If certain ones are peculiarly apt, let them, *at your order*, perform the experiment for the first time. Among the children's fragments there will be a large amount of rubbish. From time to time the teacher can propose "to assort the collections," and casually remark: "So many of these are so nearly alike, which are the *most perfect* of their kind? Let us lay such aside, and put the rest in a reference pile for a time of need." The plan is readily accepted, the "collections" greatly reduced, and the refuse piled in a corner out of doors, to gradually scatter.

No lessons will be more acceptable to the pupils than those of *erosion* and *sedimentation*, taught by calling attention to the water in the streets and gutters after a *gentle* rain, and after a *heavy* one, a *short* one and a *protracted* one. They will readily see its *assorting* effect. They will notice the little *terraces* made, and that the form of these —their comparative width and height—depends upon the *velocity* as well as *amount* of water flowing along. Note how they narrow and deepen when passing under cross-walks, and that the current is swifter. Having noted these things, call attention to any ravines, or creeks, or the river and its bank. Show that when a creek widens, the edges, on either side, are apt to be *marshy*. Why? Notice the different appearances of the bottom. If gravelly, is it clean or dirty? Why? Some pupil goes too near the edge, and the bank caves off. Why? A shrub is nearly undermined. Why? Explain how the earth, carried from these parts, is dropped, gradually, farther on.

Thus far our work has been adapted, in the main, to the city pupil with only a limited field for his sand and gravel explorations, the street gutter and an occasional excursion to some picnic ground, a grove and a creek. If a bank of *Drift* should be at hand, he will have a bonanza for these happy lessons. Pupils will then find some stones with strange markings, suggesting a *shell*, or one of the *corals* on the mantel. They have learned to observe and compare, and now draw their own inferences with a *certainty* that these *are* shells and corals, *in the stones*. Is the marking the inside, or outside, of the shell? Is it a complete shell, or only one valve? Did it probably *have* two valves, like a clam, or was it like a snail, coiled or straight? Teach them to note not only degrees, but kinds of resemblance and difference; really to distinguish between analogies and homologies. A child often really *knows* more of a thing than he has the power to *tell*, unless drawn out by questions. How did these shells and corals come *here* so high above the water? Mother's shells came from the distant ocean. Once, long, long ago, did the ocean ever come *here?* and were these *alive* then? Yes, but they are "fossils," now, petrified thoughts of God, kept all this time for us to study. They are masks without the actors, poems of life written unconsciously. Tell the class something of the habits of similar animals now, enough to stimulate them to further research. *Never*, by chart, picture or word, *tell* them *directly* what they can find out themselves from their own specimens, or walks, or speculations. *Always manifest an interest* in every new thing they discover and bring you, however trivial it seems to you. To lead them on, if possible, ask some question the answer to which is not obtained from a casual examination.

With a little plan on the part of the teacher, a very fair *working cabinet* of the locality may be built up *for the school-room.* Most children will gladly give their best specimens "for the school," especially if their names may appear as the donors upon the labels. Here they get an idea of *permanent labels* and *how to prepare them.*

Before advancing farther, we may note some of the incidental, but not less valuable, benefits to accrue from these studies—not only *the habit* of *interest* in *common things*—habits of observation, investigation, comparison, and classification, but those of industry, honesty, a supreme love for truth, a seeking for it earnestly, and a careful examination as to evidence, also to recognize the fact that one may often, by a *single* omission, reach a *wrong conclusion* and have to *acknowledge* and *correct* his error. These effects are not immediate, not strikingly apparent, but sure and enduring. I venture to assert that no single study in the usual curriculum of high school and college, aside from *the Bible*, will more fully fortify against evil influences in youth, adolescence and middle life, and cheer in declining years, than an early, continued and devoutly reverent scientific study, pre-eminently of geology, for it gives constant occupation to the senses and tends inevitably toward the highest and grandest inductions and deductions. The pleasures of observation any and everywhere, of the imagination and of reflection, connected with this science, involving as it does, and must, more or less, all the others, are themselves almost a guarantee against vice. If "the undevout astronomer is mad," much more the undevout geologist, who *touches* the very handiwork of the great Creator of this and all worlds.

Thus far we have considered *Primary* and *Grammar* grade work. In any grade, teacher and student should work *together*, and with the same great end in view. A stream rises no higher than its source. No extended laboratory is essential and but few instruments, though the more complete the *reference library* the better. President Garfield said casually that "a saw-log and the society of Dr. Mark Hopkins was a university of itself," so largely is the student the result of his *environment.* If he feels in every breath, sees in every act of his professor or teacher, a consecration of energy, a spirit of investigation, a love and zeal for the work, born of intelligent enthusiasm, every latent power in that student's being is, perforce, awakened, and his whole life is aglow with scientific research. Books have their place, and a very large one, yet any geological study founded on book knowledge *alone* is of little worth. The student *must* verify for himself, and learn by many mistakes to recognize and interpret the ordinary geologic phenomena of the field and laboratory. The teacher and pupils, with hammer, cold chisel, compass, basket and note-book, and pencil, should go together to the field, the quarry, the ravine, the gravel bank, all these being lacking, to the gutter of the street after a heavy rain, or even to the open prairie. Just the direction of the geologic study, whether structural and physical, or palæontological, must necessarily depend upon the locality of the school. The prime object to be secured is to train pupils to see for themselves, to collect their own data, then study and arrange them, drawing their own deductions. Every teacher should require of the pupils carefully drawn sections or diagrams of this or that special locality, the course of a creek for half a mile, a ravine, a sandpit or a particular quarry. So far as may be, let them be on an *approximate* scale, giving altitude, thickness, dip and strike of strata, etc. They should also collect any fossils characteristic of the layers, labelling each as from its layer, to avoid confusion in farther study. Having made a number of these investigations, each pupil should compare his or her own papers and specimens one with another, noting down their resemblances and differences, how the strata alter from one layer to another; what fossils are common to all, which abundant, which frequent, which rare; which, whether abundant or rare, are confined to a limited district, etc.

In all science study and teaching our first object should be to be *natural.* In geology this requires a familiarity with *rocks*, their form, structure, position and chemical composition. If the course, as previously indicated for primary and grammar grades, has been followed, the student is now ready, with great zeal and profit, to take up more extended field observations, and the regular lecture with a text book. All field study should be followed by a lecture or quizz by the teacher, developing the knowledge of the pupil, and adding to it materially by references, with page and paragraph, to the best authorities, the presentation of charts, pictures, photos, specially illustrative specimens, chemical experiments, etc. Far better results are obtained if, under each head, some single illustration is taken and traced as far as possible. For instance, under igneous agencies take *Vesuvius*, giving *every* thing that can be gathered, its cone, materials erupted, and their amount, the buried cities,—include, it may be, even some poetic references. Then will naturally follow the *kinds* of volcanoes, their *location, age*, the *theories* of their origin, and *earthquakes* and their phenomena. Under aqueous agencies nothing can be more stimulating and convincing than a study of our own Mississippi River, as fully described by Abbott and Humphrey. Let the pupil identify all he can. For erosive action of water on a large scale take Niagara. For both erosion and sedimentation, on a *very* small but quite *as true* a scale, take a city gutter, near its source and at its outlet. Present one typical illustration under each head so fully that it will be a *standard* for the pupil in all similar processes, whether in field, laboratory or class room.

In our own section, about Rockford, Ill., we have the Galena Division of the Trenton, outcropping in various places along Rock River, and exposed in many railroad cuts. While the general exposure is only of the yellow or buff stone, in several localities it has been quarried down to the blue. With a piece of each color in hand, and the quarry itself under close inspection, a valuable series of facts may be discovered by the pupils—the strata joints, seams, etc., whether they are equally distinct in all parts of the exposure, whether adjoining strata are decided contrasts; if so, in what respects, color, texture, homogeneity, hardness, etc. Enquire which strata are the oldest, and why so decided? Which strata are best adapted to the purpose of quarrying? As a building stone, will it be greatly affected by water? Weigh a fragment in its natural condition; dry it as fully as possible and weigh again,—a druggist's scales will give the change. Judging from various exposures, does the stone "weather" smooth or in depressions? Can you tell the original upper surface of a flagging stone from the lower? How? In building, is it better to "lay" the stone with any reference to this *original* surface? Why? With a hand magnifier of ordinary power, examine the texture of the rock, coarse or fine? Are there occasional little "pockets" in it? Is the sand in these the same as in the rock itself? Those white, irregular stones, imbedded here and there, what are they, and how do they differ from the others? They are flint or quartz,—strike them sharply with a piece of steel,—fire flies. What are those little brick-red masses here and there? How do they differ in texture and shape of grains? Is the rock firmer or less firm in their vicinity? They are iron nodules. Are they beneficial? Why? Note the reddish powder around any nodule, if kept damp, and how the stone streaks. What other forms have you found? An incrustation? *Yes. Touvertine*, a deposit of carbonate of lime from the water trickling among the strata. How do you know it is a *carbonate?* This time try nitric acid instead of hydrochloric on these peculiar forms, carbonate, quartz and iron,—note the difference of action. In this way a thousand things familiar to every geologist will be learned by the student, and bring to *him* the inspiration of a *discovery*.

The pupils have gathered all the fossils they could, whether many or few. Some are manifestly *corals* and a form allied, fossil *sponges*; others are shells. Separate them. What do they suggest as to the *origin* of the rocks? *Where* were they formed? Are they more closely allied to salt or fresh water species? Examine carefully the valves, hinge line, ribs or striæ, beak and umbo, sinus and folds. Find specimens giving both internal and external structures or characteristics, if you can. Distinguish between a *cast* and the *fossil* itself. Are the casts of any value? What? Classify, as well as may be, all the fossils collected, according to *form* and according to *internal structure*, so far as it can be traced. Not all shells that look similar on the outside belong to the same genus, nor do all belonging to the same genus look alike, necessarily. After the student has made a goodly collection of fossils and facts about them, the teacher may lead him on, with State Reports and other authorities, till the final identification is reached, but the pupil should take every step himself for himself, when able. In all these lectures and quizzes, the blackboard is an invaluable help, making diagrams as you progress, rather than present a more perfect one, completed before the class enters.

At Rockford, also, we have a fair exposure of the *Drift*. After studying the stratified rocks as such, the class is ready to study stratification as presented here, and to make further maps or diagrams. Note the sizes of the gravel stones and their arrangement. Is there a regularity in distribution as to *size* of pebbles? Few better fields in a prairie section can be found for the varied forms of quartz. Occasionally bits of mineral are found, —*galena and copper*,—the former suggesting the mining districts of Northern Illinois and Southern Wisconsin; the latter, from its form, the Lake Superior region. Fossils of various kinds are not infrequent, but of genera and species quite different, usually, from those found in the quarries and railroad cuts. The drift has brought them from several formations and from long distances. Often the internal and external structures of these specimens are better preserved than in those imbedded in the rock. Indeed, most of the best and most exact descriptions of palæozoic corals have been based upon drift specimens. The pupils having made collections of the different varieties of *rock* from the drift, the teacher may here give some ready tests of identification for common forms, or some simple mineralogical table. We have few bowlders, but those few, with the drift rocks, submit themselves to the same kind of study as rocks *in situ*, whether macroscopic, microscopic, or chemical, so are well adapted to all petrographic study, save geographical limits.

At Rockford we have the deep, heavy prairie deposit, black as are all rich soils due to the decay of vegetable substances. If this soil is *burned*, there is little change, save in color,—the mass is argillaceous matter, with a little fine sand. The stratification noticed in the walls of wells, and in artesian well borings suggests the same agency as the quarry and the drift, viz.: *water;* but the occasional shell fragments found bear little resemblance to those in the quarry, rather to our fresh-water Unio, Anadonta and Paludina, genera still living in the rivers and marshes. The inference, then, is that at some remote time, but later than the quarry and the drift with their salt-water fauna, there was a fresh-water lake, perhaps an arm of Lake Michigan, reaching out toward the Mississippi River, or the Mississippi extended this way.

As the conservation of energy has given us a new physics, so the microscopic study of rocks and fossils has given us a new geology. Though microscopic rock-sections were first made in 1854, it was not until they were introduced into Germany a few years ago, that they became an active agent in geologic research. Only by this careful method can these petrified thoughts of the Creator be fully understood. Palæontology is essentiallybiological, dealing with the plants and animals *on* the globe rather than with the life of the globe, but it has rendered an inestimable service in determining the question of *evolution*, so the microscopic section will be of inestimable service to the petrographer with his crystalline rocks, whether volcanic, plutonic or metamorphic. For making these sections let the pupils use their own ingenuity in preparing the simple apparatus really essential. If a section cutter is at hand of approved pattern, or an electric or foot-power lathe, very well; but if not, it is *just as well*, for with cold chisel, hammer and file, the student can easily reduce his specimen to a proper size for grinding. The superficial surface may be as large as preferred, but the thickness not more than one-fourth inch, if the intention is to make a *translucent* slide. If only one surface is to be ground, the only care will be to get the *angle desired* for the examination. For early work only *calcareous* specimens should be used. Let the student furnish himself with a plate 12x16 inches of floor glass, smooth on one or both sides; a half-dozen pieces of double or treble thick glass 2x2 inches, a half-dozen spring clothes pins, emery of 4-7 grades, the finest being emery "slime;" a piece of chamois skin, stretched tightly over a smooth board to polish upon; some Canada balsam, hard and soft; some alcohol, a lamp and some matches, and a little water. With a few needles in wooden handles, and a firm table to work upon, he is independent of surroundings. His patience, time and skill will be taxed; but these are the wrapping paper and cord to secure this trophy of the past, and draw from it its inmost secrets. The grinding is simply friction with emery and water till the first face is prepared, and polished on the chamois skin with *dry* emery *slime*. This should be as perfectly done as possible. The specimen may be considered as finished at this stage, if no *complete* examination of *structures* is intended, no tracing of homologies in various genera and species. If this exact study *is* to be prosecuted, on one of the small glass pieces, polished surface down, imbed the specimen in balsam, just hard enough and deep enough to securely hold it, but not so hard as to crack off, as the grinding of the second surface advances. Care must be taken to hold the glass *horizontally*, lest the specimen be of unequal thickness at the close. When *nearly translucent*, great care must be taken by grinding *lightly* and more and more lightly, till the work is complete and the polishing done. Warm the balsam which still holds it to the glass, and delicately slide the well-earned treasure to a new microscopic slide, 1x3 inches, on which is a drop of hot balsam. This successfully done, remove any air bubbles and lay on the cover glass, removing bubbles again. Clamp it with a clothes pin till dry and cold, then remove all surplus balsam with turpentine, taking care that it does not also run under the cover glass. It is now ready for study. When several specimens of different species or genera of *Rugosa*, for instance, have been made, fine lessons may be drawn in homologies, especially of mural, septal and tabular systems.

As the large majority of students will not carry their scientific studies, as such, farther than the requirements of the college curriculum, it is eminently important that their attention be called all along to certain prominent things *as* prominent, as the great questions to be sought out. In giving these special points of the field in general, the teacher or professor will naturally present in a more extended way that special field which has most attracted his or her own attention or investigation. For reference and for present benefit the pupils should each, under the eye of the teacher, make a geological map of the United States; one of his own state on a larger scale, and of his own section on a still larger one. He should also number carefully and permanently his specimens, using a tiny circle of paper and glue unaffected by ordinary moisture, these numbers corresponding to those on labels bearing name of formation, group, genera and species, with the date and locality.

In preparing this paper I have been painfully conscious of its inadequacy and its great imperfections, yet from experience and observation I hope to have measured an arc in the circle of scientific and geologic education in our schools whose circumference may be eventually completed.

LETTERS TO THE EDITOR.

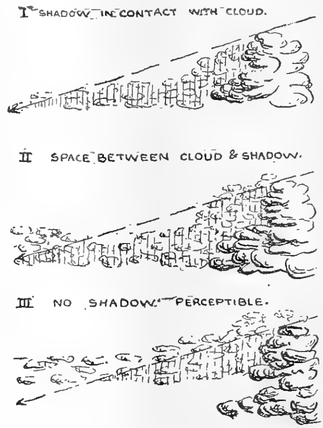
***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

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

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

An Instructive Illusion.

On Thursday evening, May 18th, occurred at York one of those smart thunder-showers which followed the break-up over the greater part of England of the sunniest, warmest and driest spring within the memory of most. Hail had fallen, and five minutes later, at 6.50, clear sky appeared among the storm-clouds. Not quite clear, however, for it was flecked with those very delicate, filmy, white clouds which one usually assigns to a very lofty altitude. The sun being within an hour of setting, its slanting rays illuminated these strongly. It was therefore with surprise that I saw shoot athwart these sharply-defined, intensely dark bars of shadow. These evidently came from a portion of cumulus-like thunder-cloud, which topped the main mass just below and to the right of the new moon. Some of the rays sprang direct from its edge, but others at a distance of 2° to 10°. In the shadow the filmy clouds were absolutely invisible, the sky seemingly being of a clear blue, although the shifting of the bars of shadow indicated their actual presence everywhere.



THE STRAIGHT LINE PARTS SUNSHINE & SHADOW.

But the strange question arises, what was the real height of the film-clouds? Must they not, obviously, have been at a lower level than this portion of the thunder-cloud, though higher than the main mass? And yet portions must have been piled higher against the thunder-cloud. Else there could not have been the illuminated space dividing the shadow from the cloud. In some cases the dark bars merged into sheets of shadow, which stretched away 20° or more from the cloud. Apparently, if seen in section, the effect must have been as in the appended sketches.

It is difficult to conceive any other explanation than the above. Hence, either such film-clouds form at lower levels than is generally supposed, or the summits of thunder-clouds penetrate higher than has been supposed.

J. Edmund Clark.

Why Not the Collections of Seeds?

In these days of stamp, coin, shell, mineral, plant and insect collectors, the writer has often wondered why it is that so few have turned their attention to making collections of seeds. The field, as it appears to me, is one of exceptional interest; exceptional not merely because of the work of real merit that may be done therein, but because it is practically inexhaustible; because the materials are very largely of such a nature as to be cared for with a minimum amount of labor, and require but little space; and because in many instances seeds are themselves objects of great beauty. There are few pursuits in which greater latitude may be allowed, or greater opportunity is given for display of individual energy and mental scope. The amateur, whether man or woman, boy or girl, business man or teacher, cripple or invalid, may each and all collect and find ample room for so much or so little study as he or she may choose to devote to it. One may collect only such seeds as have in themselves some points of beauty, or are of curious shapes; may know them only by their common or local names, or may take up the subject in a purely scientific spirit, identifying a plant during its flowering stage and finally collecting its seeds when mature, labelling them with both common and scientific names, date of flowering and seeding, and laying away to form a part of what in time may grow to be a collection of real value.

One great objection that may be raised is undoubtedly the difficulty in correctly identifying seeds. There are indeed comparatively few botanists who claim to be able to identify more than a small proportion of the plants they may know, by the seed alone. But this fact only emphasizes the desirability of undertaking just this line of work, and but serves to illustrate the well-known fact that work of real merit may not infrequently be done by the amateur who merely seeks recreation.

George P. Merrill.

Washington, Sept. 13, 1893.

Science in the Schools.

In a recent article, that well-known scientist, Dr. Groff of Pennsylvania, stated that "it has long been the dream of scientists that the time would come when the elements of natural history and of the physical sciences would be taught in secondary and primary schools." The college professor would, indeed, welcome a greater familiarity on the part of students entering their departments, with the elements of the sciences; but just where this training should begin is not so clear. There is an organized effort being made in some of our leading educational cities to establish this work in not only the secondary schools, but in grammar and primary grades as well. While science should receive a large share of attention in the high schools, and presumably in the grammar grades, is it not going just a little too far to force such work into the *primary* grades? It would certainly appear that, with all the modern innovations already introduced into the primary rooms, sufficient diversion is secured, and certainly, for pure "busy work" the ideal seems to have been reached. Then why crowd these little minds with this additional load, unless it is really superior as a means of education to those studies that are generally acknowledgde so essential as a foundation for subsequent work? Again, I submit that in this early formative period, teaching and encouraging children to capture beautiful butterflies, moths, crickets, or, in fact, any other insects, with the purpose of killing them and picking them to pieces, is not inspiring a regard for God's creatures about them, which sentiment should be instilled into these little people rather than crushed out of existence.

But I think that most agree that *somewhere* in the *grammar* grades the elements of natural history should be imparted. Such, however, is the present crowded condition of the curriculum of our grammar schools that but little, very little, time can be found for it. Nor, indeed, would it be desirable to take much of the pupil's time for such work, in view of the fact that so many studies of more practical importance in life are taught, and rightly, too, in these grades. In our public grammar schools many boys and girls are kept along from year to year at great sacrifices on the part of parents, and they should be allowed to devote their time to such studies as they will most need. It would, therefore, be manifestly unfair to attempt more than the most rudimentary science work in those grades below the high school.

Henry Edgerton Chapin.

Ohio University, Athens, O.

The Ikonomatic Method.

It is strange how difficult it seems for some writers to understand this early, simple and widespread method of recording sounds.

Dr. Thomas in *Science*, Sept. 8, presents a singular instance of this, when commenting on my explanation of the use of the turtle-sign in the glyph for the Maya month-name Kayab. He says: "A compound of *ak* and *yab* cannot be a derivative of *kay*." Of course not! The nature of the ikonomatic theory forbids it; for this has reference not at all to derivation, but to other word or words with solely homophonic, and not etymologic, affinities.

When there are so many examples of ikonomatic hieroglyphs presented in a work so accessible and recent as Dr. Antonio Penafiel's "Nombres Geograficos de Mexico; Estudio Jeroglifico," it is scarcely excusable for those who study American archæology either to overlook or to misunderstand this system of writing. D. G. BRINTON.

Media, Pa., Sept. 19.

A CURIOUS EAR OF INDIAN CORN.

A CURIOUS freak of nature was recently discovered in a garden in this city. A stalk of maize or Indian corn failed to develop any ears at the regular places in the axils of the leaves, but instead a single spike of pistillate flowers (an ear) appeared at the end of the central pedicel of the tassel. This ear was about three inches in length, and apparently well formed, except that it lacked glumes. So being exposed to the sun its color was light green. The styles were perfectly developed, and six inches to a foot in length. The places of a few of the grains were occupied by staminate flowers.

Unfortunately this ear was not allowed to grow, and I am unable to say whether it would have developed any perfect grains or not.

Is it a reversion to some ancient form; or only an accidental variation? O. H. HERSHEY.

Freeport, Ill.

A MOUSE DESTROYING ITS YOUNG.

I ONCE had an opportunity of studying a mouse in a cage with a revolving wheel which it was fond of turning, as squirrels are larger but similar wheels. This cage had an apartment over the wheel in which it built a nest from cotton furnished to it. It gave birth to three young mice in the lower apartment, and after a little while removed them to the nest above. One of these young fell out of the nest to the space below. The mother carefully carried it back again. It fell out a second time and was once more replaced. It fell out a third time. The mother then seized it as if angry and unwilling to waste her energies on so troublesome an offspring, and devoured it with no more feeling than if it had been a bit of cheese. M. L. HOLBROOK.

GENEALOGICAL TABLE OF PLANTS.

COULD you or any of the readers of *Science* inform me through your columns where I can find a printed list or table showing the supposed relationships of the commonest genera of plants under the theory of evolution? In other words, I should wish to find a genealogical table of plants from the earliest times to the present day. Has any such work been attempted? THOMAS MARWICK.

New York, Sept. 21, 1893.

NUMBER-FORMS.

NUMBER-FORMS, such as described by Mr. Martin and Mr. Talcott Williams in recent issues of *Science,* were first brought to notice by Mr. Francis Galton in *Nature,* Jan. 15, 1880. In his "Inquiries into Human Faculty" (Macmillan, 1883) there are illustrations of more than fifty varieties of number-forms. A still larger number is given in a recent book by Flournoy (Des Phénomènes de Synopsie, Alcan., 1893). J. MCKEEN CATTELL

Columbia College, N. Y., Sept. 19.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

For Exchange.—Books and pamphlets on geology, ornithology, conchology, and entomology. State what line and I will send list. I want Odonota from any locality, and literature on this group. M. J. Elrod, Ill. Wes. Univ., Bloomington, Ill.

For a rare chance to get a first-class microscopical outfit write for full particulars to box 125, Sellersville, Bucks Co., Pa.

For sale or exchange.—A fine collection of Lepidoptera, native and exotic. For particulars address Addison Ellsworth, Binghamton, N. Y., care Republican.

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U. S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 – will exchange for any works or pamphlets on American Slugs or Anatomy of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

Wants.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc.," etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

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A GRADUATE of an American Polytechnic institution and of a German University (Gottingen), seeks a position to teach chemistry in a college or similar institution. Five years' experience in teaching chemistry. Address Chemist, 757 Cary St. Brockton, Mass.

WANTED.—A position as teacher of Biology, by an experienced teacher, a college graduate with four university post-graduate courses in the Sciences. Good endorsements, and eighteen years' experience. Address A. N. Somers, La Porte, Ind.

SCIENCE

ELEVENTH YEAR.
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OCTOBER 6, 1893.

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SCIENCE

NEW YORK, OCTOBER 6, 1893.

CURRENT NOTES ON CHEMISTRY.—III.

[*Edited by Charles Platt, Ph. D., F. C. S.*]

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

THE International Scientific Congresses recently held in Chicago have attracted world-wide attention and have rightly been accepted as *the* feature of our great "Fair." But other meetings have also been held this summer, several of rather more than usual interest. At the meeting of the Iron and Steel Institute many valuable papers were presented, and more recently the meeting of the British Association for the Advancement of Science was opened at Nottingham, September 13. For some years past and for no well-founded reason, the meetings of the British Association have been but lightly attended by the pure scientists, but this present year, largely through the labors of Prof. Emerson Reynolds, M. D., Sc. D., F. R. S., President of the Chemical Section, Section B., a larger attendance was secured and a superior programme obtained. An attractive feature was the lecture by M. Moissan, on the preparation and properties of the element fluorine, together with exhibitions and demonstrations of his progress in chemistry and high temperatures.

Professor Reynolds's opening address before Sec. B. is an epitomized review of the work done during the past year, with special attention to certain features of advance made in our knowledge of chemical theory. Reference is made to the methods of inquiry and study in medicine, and while vast progress is shown during the past twenty-five years, the present state of the chemical branch of this instruction is deplored as leading to a knowledge of substances rather than of principles, of products, instead of the broad characters of the chemical changes in which they are formed. Without this higher class of instruction it is unreasonable to expect an intelligent perception of complex physiological and pathological processes which are chemical in character, or much real appreciation of modern pharmacological research.

A side light is being thrown on the nature of the elements by the chemico-physical discussion between Armstrong and Hartly as to the connection existing in the constitution of certain organic compounds and the colors they exhibit. We may take it as an established fact that a relation exists; and, if so, then why may not elements of distinct and characteristic color be considered as complexes analogous to definitely decomposable substances? The two elements, nickel and cobalt, of decided color in their salts and in their metallic plates, add strength to this idea in that they may be considered as exhibiting a sort of isomerism. Their atomic weights are the same within limits of experimental error; and, by analogy with compounds, identity of atomic weight implies dissimilarity in constitution and therefore definite structure.

The genesis of chemical elements is now being studied with the application of the principles of gravitation. Mendeleef, in 1889, first proposed to apply Newton's Third Law, and now Rev. Dr. Houghton in recently published papers applies the three Newtonian laws to explain the interactions of chemical molecules, with this difference only, that atoms have a specific coefficient of attraction varying with the nature of the atom concerned, whereas the specific coefficient of gravity is the same for all bodies independent of their composition or matter.

The remainder of Dr. Emerson's paper is devoted to a sketch of comparative chemistry, of great interest but rather difficult of condensation. Silicon is considered as an analogue of carbon. Nitrogen compounds of silicon are prepared and described, but it is shown that the combination is not a natural one and that, as silicon dissolves freely in molten aluminum, so in nature it is with aluminum that it most readily combines. Aluminum may then be considered, in this respect at least, as analogous to nitrogen. The natural alumino-silicates are, according to this standpoint, products of the final oxidation of sometime active silico-aluminum, analogues of carbo-nitrogen compounds rather than ordinary double salts. The alumino-silicates of the primary rocks are thus oxidized representatives of substances which foreshadowed in terms of silicon, aluminum and oxygen, the compounds of carbon, nitrogen and hydrogen required at a later date of the earth's history for living organisms.

PRODUCTION OF PURE OXYGEN FROM AIR AND FURNACE GASES.

A NUMBER of processes for the manufacture of pure oxygen from air have appeared recently, all following in a general way the suggestions of the well-known "Brin" process. Herr G. Kassner in the *Chemiker Zeitung*, claims a superiority for a salt of calcium, the calcium plumbate, Ca_2PbO_4, his process being briefly as follows: The plumbate in spongy porous pieces is exposed to the action of moist furnace gases which have previously been well washed. Carbonic acid is absorbed by the calcium salt with decomposition, forming calcium carbonate and free peroxide of lead. This decomposition is unaccompanied by a change of form. The resulting mass is transferred to a strong retort heated to redness. Oxygen is disengaged and the evolution facilitated by a stream of superheated steam. Finally carbonic acid is given off and in the last stages this is pure. In the intermediate stage the gases are passed over calcium plumbate and the carbonic acid there absorbed leaving the oxygen pure. Another similar process has been patented by Peitz, calling for the use of pure carbonic acid.

Le Chatelier proposes a direct method of heating to drive off the oxygen and a reabsorption of the oxygen from the air, but Kassner, who has already experimented with the direct method, considers the higher temperature, the larger expenditure for fuel necessary, and the consequent greater wear upon the retorts, serious obstacles successfully overcome only by his later indirect method.

Mr. L. Chapman, London, has patented a process depending upon the alternate oxidation and reduction of a mixture of manganese dioxide ("or a similar substance") with caustic soda by means of air and steam respectively. Finely divided manganese dioxide and caustic soda in the proportions necessary to the formation of the manganate are mixed with a weight of sodium sulphate equal to the weight of caustic soda taken. Air is passed through small pipes leading nearly to the bottom of the vessel, thus assuring mixture and oxidation by the uprising current. When the oxidation is complete the air is shut off and the air in the upper parts and in the supply and exit pipes removed by means of steam. Dry steam is then passed. Nitrogen is obtained with a slight modification, by collecting the gas which escapes during the oxidation and again passing it through the mixture.

Electro Deposition of Iridium.

At the Madison meeting of the American Association, Dr. Wm. L Dudley described his method for maintaining a constant metallic strength and purity in an electrolytic bath for the deposition of iridium. The electrolytic solution of the metal from an anode was of course desirable, but was found to be a tedious and expensive process. Success was finally attained by the use of (1) an oxide, or (2) a hydroxide, these to be insoluble in the electrolyte but freely soluble in the acid radicle set free at the anode. Iridium hydrate, $Ir(OH)_4$, was employed suspended in loose-fitting linen bags between the carbon anodes. Sodium iridichloride and ammonium iridichloride gave satisfaction as did also a solution of the hydrate in sulphuric acid with the addition of ammonium sulphate.

Dr. Wm. H. Wahl had evolved the same process for the platinum group after much independent study parallel with that of Dr. Dudley.

Commercial Organic Compounds by Electrolysis.

The production of commercial organic compounds by electrolysis is a significant step in the advancement of electrolytic methods. F. Bayer & Co., of Elberfeld, are now producing the periodides of the phenols and the phenol-carboxylic acids by subjecting mixtures of solutions of the alkaline salts of phenols and of alkaline iodides to the action of the electrical current. A solution of the alkaline iodide is prepared and in this are immersed the electrodes separated by a diaphragm. The current is passed and at the same time an alkaline solution of phenol is gradually added. Two amperes per square decimetre of electrode surface is sufficient. In a few hours the phenol becomes entirely converted to the periodide, which separates out in solid form.

The electrolysis of a solution of ferrous sulphate to which a weak solution of proto-chloride of iron, sodium, potassium, calcium, vanadium or magnesium has been added produces a basic sulphate of the peroxide. Adding the equivalent of sulphuric acid before or after electrolysis forms the tri-sulphate of the peroxide of iron which is used in the preparation of dried blood manure.

MM. Hermite and Dubosc cause ferrous sulphate to circulate in an electrolytic apparatus, arranged to maintain a maximum amount of the salt in solution, and so obtain a saturated solution of the sulphate of the peroxide. By varying the current in density and duration more or less of this salt may be formed, constituting the various mordants known as "rust," "sulpho-nitrate" and "persulphate of iron." The apparatus consists of an enameled iron tank with an outlet for draining at the bottom, a perforated pipe in the lower part for supplying the solution, and an overflow at the top. The electrodes are plates of iron and thin sheets of platinum.

Determination of Iron and Silicon in Commercial Aluminum.

Dr. A. Roessel gives the following process for the determination of iron and silicon in commercial aluminum. Three to four grammes of the metal are gradually introduced into 35 cc. of hot potash lye (30–40 per cent). The metal dissolves leaving a black floculent residue. The solution is now supersaturated with pure hydrochloric acid in a platinum crucible without previous filtration, and is then evaporated to dryness. The mass is moistened with hydrochloric and the silica is determined in the ordinary way. For the determination of the iron, Roessel dissolves 3–5 grammes of aluminum as before and mixes with an excess of dilute sulphuric acid. The solution is heated until clear and is then titrated with potassium permanganate. The potash-lye used must, of course, be tested for silica.

NOTES AND NEWS.

The American Book Company have issued several books for the study of classics, some of them new, and some merely new editions. Of the latter class are "Arnold's First and Second Latin Book" in one volume and "Arnold's Latin Prose Composition." These works, which have been in use for many years, have been revised by James E. Mulholland; the revision being confined to the correction of errors and a few minor additions, without changing the essential character of the original works. The two other classical books that lie before us belong to the series of which President Harper, of the University of Chicago, is one of the editors. In editing "The Aeneid (six books) and Bucolics of Vergil" Mr. Harper has been assisted by Frank J. Miller, instructor in Latin in the same university; and the edition they have prepared differs in some respects from most of those now in use. An important feature of the work is the series of "Inductive Studies," mostly grammatical, which precede the poem itself, and in connection with the notes and the vocabulary, are designed to give the student his grammar, notes and lexicon all in one volume. The book also contains twelve full-page illustrations, being reproductions of noted works of art. The other volume in the same series is an edition of the whole of "Xenophon's Anabasis," prepared by President Harper and James Wallace of Macalister College. This also contains inductive exercises and other grammatical helps, together with notes and a vocabulary. There is also an introduction showing the historical setting of the Anabasis, with a description of the Greek and the Persian modes of warfare and many pictorial illustrations of warlike material and other appurtenances of ancient life. These books are well printed and substantially bound.

—The Minnesota Academy of Natural Sciences, in conjunction with the St. Paul Academy of Sciences, made an excursion on Sept. 16 to Taylor's Falls, on the St. Croix River. The party numbered eighty persons. The sandstones overlying the Cambrian igneous rocks through which the St. Croix River passes, forming a beautiful erosion gorge and the bowlder conglomerate formed of the broken down igneous rock were inspected. The early age of the conglomerate is demonstrated by the presence in it and in the cementing sand of fossils of certain date. Pot-holes of great size are seen there, one into which access is possible holds more than twenty persons at one time.

—Messrs. Macmillan & Co. announce a second edition of Professor Goldwin Smith's brilliant sketch of the United States, the first edition of which was exhausted in two weeks. Written by an Englishman who regards the American commonwealth as "the greatest achievement of his race," this book must possess a peculiar interest for American readers.

—M. L. Holbrook, New York, will publish early in the Autumn another book by Bertha Meyer, author of "From the Cradle to the School," entitled, "The Child, Physically and Mentally; Advice of a Mother according to the Teaching and Experience of Hygienic Science; a Guide for Mothers and Educators." It has been translated by Friederike Salomon, revised by A. R. Aldrich.

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COLLECTION OF MEXICAN MAGUEY PAINTINGS.

ALEXANDER VON HUMBOLDT—America's scientific discoverer, as he was called after his return to Europe from this continent—when sojourning in the City of Mexico (1803) took care to acquire a certain amount of ancient hieroglyphic paintings, which, among other relics of Aztec civilization, had once been collected by the Cavalier Boturini Benaducci, yet were confiscated by the government of New Spain, and later on handed over for study to Leon de Gama, a professor of astronomy in whom the learned traveller had found a coadjutor for his manifold scientific pursuits.

In 1806, Humboldt made this precious purchase a present to the Berlin Royal Library, in the shelves of which the large portfolio had been resting, "not disregarded, but unopened," until the year 1888, when it was brought to light for the inspection of the Members of the Congress of Americanists assembled in the same year in the city of Berlin. The collection consists of sixteen sheets of maguey paintings in more or less fragmentary condition, the photographic facsimiles of which were published a few months ago at the cost of the Royal-Library, to be its special commemorative gift to the Columbus Centennial Celebration. Only three copies of it have reached the United States. The sheets are about one foot ten inches wide, and two feet six inches long, with the exception of No. I., which shows the considerable length of fifteen feet by one foot ten inches.

The task of interpreting the paintings devolved on Dr. Eduard Seler, Curator of the American Department in the Ethnological Museum of Berlin. The text he wrote forms a book of 137 pages, octavo, with a carefully arranged index. The headings of the sheets are inscribed as follows: No. I.: A list of tribute extending over nineteen years and paid by trimester to a certain temple. II.: A list of the lots of the Royal Domain *Camaca* and of their former usufructuaries. III. and IV.: Fragments of historico-geographical contents, originating from *Huamautla* (Tlaxcalla). V.: Fragment of a household ledger, village *Tecontepec*. VI.: A court proceeding in the city of *Tezcuco*. VII.: Account of certain victuals furnished by the mayordomo of *Mizquiyauallan*. VIII.: Fragment of a catasterroll, with name of proprietor, area and quality of soil. IX–XII.: Fragments of court-trials (complaints). XIII.: Account given by the mayordomo of *Mizquiyauallan* of work done weekly by women of the pueblo. XIV.: Account of wood, forage and victuals furnished. XV.: An account of turkeys furnished. XVI.: The Articles of Faith and the Ten Commandments, both in hieroglyphics.

Here, then, at last, some fresh material for study has made its appearance, which the students of Mexicology were a long time yearning for, in view of the scanty and somewhat superannuated stock of Mexican Calendar Codices. If nothing else, the diversity of contents alone must have gladdened the heart of the enthusiastic interpreter, and have paid him richly for the labor bestowed on the work. "I have learned something," he exclaims somewhere. One portion of the sheets (Nos. I., III., IV.), turned out to contain records written in the epoch before the Spanish Conquest; other records reach as far as the year 1571. This fact is of some importance. For in the former the names of persons and places still appear in their primitive ideographic simplicity, whereas in the others the influence of modern syllabic spelling makes itself noticeable—a subject often ventilated with regard to the absolute reliability of certain Codices. On the other hand, some of the sheets afford a graphic insight into the economic comfort of the *curas* and *encomenderos*, by exhibiting the quantity and good quality of all those things that were to be supplied by the parishioners and tributaries for the sustenance of the ample households of their taskmasters. Sheet No. II. is of specific historical interest. It shows us *Moctezuma* II., the Severe, arrayed in file with his successors, generals and other dignitaries, inasmuch as they were authorized by the Spanish Crown to remain keepers and heirs to certain portions of land, up to the demise of the last blood-relative of the unfortunate dynasty. In No. VI. we recognize a painting already published and described by Humboldt himself in his great work: "Vues des Cordillères et Monuments des Peuples indigènes de l'Amérique." He took it for representing "un procès entre des naturels et des Espagnols," the object of litigation being a farm. We learn from Dr. Seler that the object of the process was not a farm, but a claim about the extent and boundaries of the Royal city of *Tezcoco*, whose prominent edifices and hieroglyphic name are delineated on the plan, together with her last King *Teauilotzin* and certain known members of the Royal Audiencia. The last sheet, No. XVI., is a veritable curiosity. It is one of those pictorial illustrations of the Roman Catholic Catechism, which the missionaries used to hang on the walls of the parochial schools for the purpose of helping the natives to learn by heart the principal tenets of the Christian religion. These wall pictures are mentioned by Bemesel and Las Casas. This Humboldt specimen, however, is the first that has cropped out from scores of them that must have existed.

We cannot help expressing our highest admiration for the skill with which the learned interpreter has solved the riddles laid before him. The sense of each of these sixteen problems is as ingeniously grasped by him in its whole, as it is methodically proved and explained in all its details. In this Dr. Seler has shown that he has mastered the true methods of inductive argumentation. But he is also possessed of the great gift, so to speak, of pictorial intuition and vision. Without the aid of this felicitous talent there is not much chance for the interpreter of ideographic writing either to seize the correct meaning of each individual symbol and hieroglyph, or, when he has done so, also to combine the various elements into that text which the native hierophant would have written had he been acquainted with the resources afforded by our alphabet. V.

—Dr. William Patten has been appointed Professor of Biology at Dartmouth College, Hanover, N. H. The department is a new one and will be well equipped.

RING PHEASANT.

BY A. G. PRILL, M. D.

PHASIANUS TORQUATUS, (Grml). Common name: Chinese or Mongolian Pheasant.

Habitat: Western United States, Willamette Valley and southward into California.

Description—Male, total length 34 to 40 inches. Length of tail, 15 inches to 24 inches. Bill dark, 1⅜ inches long. Iris yellow. Crown, greyish green, with a white stripe extending over each eye. Around the eyes is found a large red patch of hair feathers.

Neck: Changeable green and purple, following which is a circular band of pure white, extending around the neck, and from this it receives its name.

The breast and points of the shoulders are a changeable, fire red and purplish blue, the border of the feathers being tipped with blue. Following in the median line is a narrow strip of blue feathers, which gradually emerge into black, as we approach the under tail coverts, which are greyish brown.

The tail consists of 16 feathers, the outer ones being shortest and gradually becoming longer, up to 15 or 24 inches, the two centre feathers being longest. The under coloring is greyish black; the upper, brown, with light gray and black, and brown bars.

Upper tail coverts, Irish green, bordered with old gold and tinged with bright green.

Under wing, grayish white. Body light yellow, and end of feathers tipped with blue.

The female has none of the bright markings of the male, and is about two-thirds the size of the male, of a uniform mottled pale yellow, with slight shades of brown, black and gray variously intermixed.

The above description, although deficient in many respects, will, I hope, convey some idea of the beauty of this species. The description is taken from an adult male and female in my collection.

This bird was imported from China by O. N. Denny some eight years ago. Six pair were let loose on Petterson Butte, about four miles from this place (Sodaville, Ore.), and the climatical conditions and country being favorable and being protected by a strict law for six years, they have multiplied rapidly, and now are one of our most common game birds. In fact they multiplied so rapidly that long before the six years' protection had ceased, the farmers complained bitterly that the birds were a serious damage to their grain and gardens, and many birds were killed, but in this I think they were mistaken, for in my examination of many stomachs, at all seasons of the year, I found but very little grain as their food, but many wild seeds, bugs, grasshoppers, etc.

I think that the farmers have realized this, also, to some extent, as nearly all have now posted trespass notices for their protection.

The birds are not as abundant as two years ago, as many were slaughtered by pot hunters for the Portland and San Francisco markets.

The bird is an easy wing shot, but has many devices to deceive the sportsman. I have known them to lie so close that in passing within four feet I did not discover the bird, and the bird will not fly until seen by you, and then it is off like a flash, making a great noise and cackling. They are very swift of foot; it requires a good dog to catch one that has been winged.

The breeding habits are somewhat peculiar. The female deposits her first complement of eggs about April 10 to 15. As soon as the young leave the nest they are taken in charge by the male, and the hen proceeds to lay a second complement of eggs, which in each case is generally ten to fifteen eggs. As soon as hatched the male also takes these in charge, and the female deposits a third sitting, which is generally about eight eggs. When these are out of the shell, one can see the entire band of three broods and male and female together. Two broods are always raised, and in many cases three. Only a few days ago I saw a brood not over ten days old. They nest upon the ground, which is generally a mere hollow, lined with leaves, under some small bush or in a clump of grass and in an open field.

Oat stubble field is a favorite resort, also fern ridges.

In captivity the birds do well and even breed, but are never domesticated, for as soon as let out they at once fly away and do not return.

The bird seems to be fearless, coming into the barnyard and feeding with the fowls.

During the spring the males crow similar to our fowls. This is during the mating season. Their love antics are queer and grotesque.

The males strut around the females, with wings drooped and tail expanded and elevated, all the while uttering a low gutteral sound. This performance is kept up for hours at a time.

During snow storms and frosty weather, many birds are caught here, as in roosting over night the long tails of the males freeze fast in the snow, and they are unable to get up, and one can walk up and pick them up.

I hope that the bird will, in time, be introduced into other parts of the United States and flourish, and thus give to our country one of the most beautiful game birds known.

THE BENDIGO GOLDFIELD.

BY T. S. HALL, M. A., CASTLEMAINE, AUSTRALIA.

THE first portion of a report by Mr. E. J. Dunn, on the Bendigo Goldfield, has just been issued by the Victorian Department of Mines and is full of interesting matter, put both clearly and concisely. The rocks of the field were long ago referred by Prof. Sir F. M'Coy to the same horizon as the Lower Landeilo rocks of Britain. The auriferous quartz reefs show a very peculiar structure. In most cases they occur as lenticular masses, arching over the anticlinal axes. North and south, in the direction of strike, they extend in some cases for miles, while in the direction of the dip they thin out rapidly, rarely extending for 300 feet. Mining operations show a series of the "saddle-reefs," as they are termed, one below the other. In the Lazarus mine, for instance, in sinking 2,200 feet, no less than twenty-four of these "reefs" were encountered. It is evident, that during the process of rock-folding, which has produced an average dip of 65°, cavities were produced between the beds into which the quartz segregated. It is, of course, a well-known fact that the axis of an anticline is rarely a horizontal line, but undulates more or less vertically in the direction of its bearing, but till Mr. Dunn's report, based on careful survey, appeared, the full bearing of this fact on our auriferous rocks was overlooked. This "pitch" of the anticline in Bendigo rarely exceeds 30°, but a case is quoted where it was as high as 60°. As the "saddle-reefs" lie between the bedding planes the "pitch" had, of course, been recognized by the miners, who appropriated for it, most unfortunately, the geological term "dip." As a consequence of this pitch, the deepest rocks are brought to the surface in the central portion of the area, and are the most highly auriferous. Surrounding this area is a larger one, in which the reefs do not yield gold so freely. Surrounding this second area is a third area, consisting of the highest rocks of the district and in which gold has not been found in payable quantities. The extent of the central area is about ten square miles.

No attempt has as yet been made to work out the graptolite zones in these rocks, but it seems probable, considering the enormous thickness of the rocks, that such zones will be found. The most plentiful graptolite of the central area is *Tetragraptus fruticosus*. Besides this form there are two other species of *Dedymograptus*, *Tetragraptus quadribrachiatus*, *T. bryonoides*, *Dichograptus octobrachiatus*, *Loganograptus Logani*, *Goniograptus Thureaui*, *Phyllograptus typus*, *Thamnograptus typus*, and some forms apparently referable to *Dendrograptus*. All these species, it will be remembered, occur in the Quebec group of rocks. A crustacean of common occurrence is *Lingulocaris M'Coyi* (R. Etheridge jun.). This is the same as the oft-quoted *Hymenocaris Salteri*, a manuscript name of Professor M'Coy's. Two species of *Protospongia* occur, but are rare.

The extension of the Bendigo rocks to the southward along the line of strike is cut off by a newer granite, which is about ten miles across. To the south of this again comes the Castlemaine goldfield. The river gravels of this area, both recent and tertiary, were very rich in gold, but although a few rich "reefs" were found they did not prove of a permanent character, and mining is now at a very low ebb in the district. The structure of the country is similar to that of Bendigo. The anticlines succeed one another very rapidly, being only about three hundred yards apart, as a rule, and the strike is very constant. The main axis of elevation passes through the township of Chewton, about two miles east of Castlemaine, and the lowest beds contain a graptolitic fauna, apparently identical with that of Bendigo. Two or three other zones may be recognized overlying this one. *Tetragraptus fruticosus* does not range above the lowest zone. *Didymograptus bifidus* is the commonest fossil in the next zone, and the problematical *Didymograptus caduceus* of Salter marks the next. The other recognized species agree very closely with those of the Quebec group, species of *Tetragraptus*, *Dubograptus*, *Logarograptus*, *Goneograptus*, *Temnograptus*, *Thyllograptus*, *Dendrograptus* and *Thamnograptus* occur.

THE MARINE TERTIARIES OF AUSTRALIA.

BY T. S. HALL, MA., CASTLEMAINE, AUSTRALIA.

TERTIARY beds of marine origin are extensively developed in the southern portion of Australia, forming a more or less broken fringe along the coastline from the head of the Great Australian Bight to the Snowy River in the east of Victoria. With the exception of a prolongation up the basin of the Murray River they do not extend far from the coastline and attain no great height above the sea. They are absent from the eastern coast of Australia, being apparently faulted below sea-level. Till of late years very little has been done towards the elucidation of the fauna, only a few species having been described. Recently, however, Professor Ralph Tate, of Adelaide, has done a great amount of work among the Mollusca and Echinoderms of the series and has enabled several workers to enter the field. The fauna is remarkably rich, especially in the older rocks, and not far short of 2,000 species have been recorded. The limit is far from reached, as fresh forms are coming to light at every new locality visited. Several papers descriptive of the beds as seen in different localites, with more or less imperfect lists of fossils, have appeared in the publications of the Royal Societies of South Australia and of Victoria. The most exhaustive one is by Mr. J. Dennant, on the beds of Muddy Creek, Victoria.*

More recently Professor Tate and Mr. Dennant have, in the same publication, begun the work of correlating the whole series of beds as shown in the two colonies.

By Professor Sir F. M'Coy the lowest and most widely occurring beds are referred to Oligocene age, and he refers others, which differ lithologically, to the Miocene. Messrs. Tate and Dennant class both as Eocene, and it has been shown that in one locality at any rate the so-called Miocene really underlies the so-called Oligocene. The lists from Muddy Creek, above alluded to, show 511 recorded species, of which only one and a half per cent are living at the present day.

The fauna of the older tertiaries presents a more tropical aspect than that found on our coasts at the present day. Murex, Vobeta and Cypræa are extensively developed and often of gigantic size; the *Cypræa gigas* of M'Coy, for instance, is a very globose form and reaches the length of eight inches.

The strata consist of sands, clays and limestones, the latter being usually composed in the main of polyzoal remains. In some places an Orbitoides limestone occurs, the chief species being *O. Mantelli*. The clays yield the greatest numbers of forms, which in some places are beautifully preserved in a stiff blue clay that cuts like new cheese.

The Miocene beds of Tate and Dennant are not so extensively developed as the Eocene, while Pliocene beds with marine fossils are still rarer. In many places marine gravels occur, which have been ascribed to this age, but apparently on very slight grounds. Where they will be placed now is quite uncertain.

Below the lowest marine beds, and frequently separated from them by a denuded basalt-flow, is, in some places, a series of terrestrial and fresh-water deposits with plant remains with beds of lignite. These have, for many years past, been spoken of as Miocene. It is now proposed to remove them to the Cretaceous. It will be a strange thing if we have to wage war in a case so closely comparable with the Laramie one.

*Trans. Roy. Soc. S. Australia.

THE SCIENTIFIC MAN ON THE FARM.

BY CHARLES B. COOK, OWASSO, MICH.

For many years the average farmer has been a man of few resources. His city brother has outwitted him in every department of his business. He has availed himself of no opportunity to secure a scientific education, and still worse, his county paper is the only periodical that ever enters his dwelling. As a result he is ignorant of the most vital laws that underlie farm husbandry in all of its branches and "farms it" in a general "go-as-you-please" style. These facts alone are sufficient to account for the farmer's general reputation as a man totally unfit for any other business. To make a bad matter worse, the illiterate farmer is continually belittling his profession to an extent that is limited only by his vocabulary.

In direct contrast to the above style of farmer the scientific agriculturalist is growing more and more to take hold of the farm, not only as a field for experiment and study, but as a vocation that will generously respond, financially, in direct proportion to the amount of mental force applied; for it is a fact just beginning to dawn on the minds of the public that the farmer's bank account compares most favorably with that of his professional brother, and where genuine ability prevails, coupled with a love for the vocation wherein one is called, the farmer's account is likely to run ahead.

The educated farmer of to-day is placed almost beyond competition, while the lawyer, the mechanic and the doctor find talented competition on every corner. The scientific man's education enables him to make the most of the occult laws of nature governing farm life. By a knowledge of economic botany he is able to make the most of his soil and crops by a judicious selection of plants best adapted to his farm, both as regards soil and climate.

Insect enemies are becoming more numerous as the country grows older. New insect pests are continually arising, and those that for long years have been branded as *"thieves and robbers"* in the Old World are being continually introduced. While these insect pests are a constant thorn in the flesh to the illiterate farmer, the scientist is able to ward off their attack, and thus be greatly benefited, personally, by their general depredations. The same is also true of germ diseases, such as pear blight, peach yellows and the like, as such diseases make large crops and correspondingly large prices possible only in the hands of the skilled horticulturalist.

A knowledge of physiology is also of great use to the man who would make the most of the farm. Plant physiology and veterinary science are branches of farm economy the importance of which is just beginning to be realized.

And last but not least the educated farmer is a man able to devote much time to the literature of the day. In the farm journals he finds the latest and best ideas of the most progressive men which aid him in thinking and planning for himself, and in turn contributing his mite to the agricultural press.

There is an old saying that education drives men from the farm, but we are just coming to recognize the fact that the average college graduate with a scientific education, finds on the farm an opportunity for original investigation and financial success fully equal or exceeding that in any other vocation. This assertion finds abundant proof in the lives of many practically scientific farmers, and also in the fact that numerous college men are going onto farms every year, who become enthusiastic and devoted agriculturalists that hold their farms in the highest esteem.

We are rapidly approaching the time when a "survival of the fittest" basis must characterize the life of the American farmer. In times past our vast areas of tillable land have formed a basis for almost exhaustless agricultural operations. This state of affairs, coupled with the fact that a man failing in all other vocations can make a living on a farm—provided he possesses only the power of mimicry born of ignorance—is sufficient to explain the low intellectual standard on the farm, and also accounts for the manner in which the cheap farmer is universally held in derision.

Severe competition on the farm is already being felt and the poorest managers are continually going to the wall. We forget that it is the man that hampers the agricultural profession and not the farm that grinds its occupant.

The educated agriculturalist is slowly but surely driving the uneducated and unthinking man from the field. With the retirement of every quack and the corresponding advent of the thinking man on the farm arena, is elevated the whole agricultural profession, which is thus brought one step nearer its true position that it justly held in Roman times—the foremost rank of all the world.

The uneducated man goes onto the farm as a last resort. His other resources have either failed or never materialized, and he is compelled to eke out an existence in what he considers a belittling business. On the contrary, the educated man goes onto his farm out of love for his chosen vocation, respect for his farm and faith in his ability to make the farm an unqualified success. He makes his home a model of comfort and convenience that may well excite the envy and admiration of his most well-to-do city brother. For besides the comforts and luxuries within his reach he enjoys absolute peace and seclusion unknown to city life.

Let us have more men with active brains and more culture and refinement in rural life, and we will hear less of unproductive and abandoned farms and less of farmers' boys going to the city for a more congenial business.

THE ECCENTRICITIES OF A PAIR OF ROBINS.

BY OLIVE THORNE MILLER, BROOKLYN, N. Y.

One never looks for eccentricities in the robin family, and great was my surprise at the curious conduct of a pair who came under my observation last Summer. I fear their heads were turned by a disappointment to begin with, for they successfully raised a brood of three in a nest under the edge of the veranda roof, and never displayed any vagaries. When the young birds had flown, the deserted nest was removed, because the veranda was to be painted.

On beginning to think of a second brood, they seemed greatly disturbed at the loss of their nest. They had fixed their hearts on that veranda, and for days they could not give it up, and judging from subsequent events I am inclined to think it seriously unsettled them. They inspected every corner, the top of the columns where the nest had been, the support that held a string of corn for the squirrels, a peg driven in under the roof, the niche over the door, the chinks in the lattice,—none of them were satisfactory, and at last they turned their attention elsewhere.

They did not seem to please themselves, although several times we thought they were settled, and one day it became plain that trouble was brewing between them. Like some bigger folk, they had let their mutual calamity sour them toward each other.

Madam had plainly selected for the new homestead a delicate crotch on a frail branch, close beside the veranda where her heart was. This was the first sign of aberration of mind, for it was an absurd choice, ludicrously inadequate to the demands of a robin's nest, and her sensible little spouse refused to consent, but kept himself out of sight and hearing of such folly.

But she had made her decision; she began to build. The first I saw of her, she came with a beakful of dried grass from the lawn, flew up to the selected branch near the tree, and then ran out on it as on a path, till she reached the crotch. I was delighted. I had long wished to watch the whole process of building a nest, and here I saw my chance. It was in plain sight, and the robins had learned not to fear us. I placed myself, and the show began.

The bird came with her mouthful of grass, as I said, and when she arrived at the spot, she simply opened her beak and let her load fall. Some of it lodged in the crotch, but most of it fell to the ground. Down she went at once and gathered it up, returned by her pretty path,—and repeated the performance!

Then a kind bird-lover from the house scattered some short pieces of string on the walk for her use. She saw them at once, came down, gathered up an enormous beakful, returned to her branch, and dropped them as she had the grass. Hardly a particle lodged, and she went down and brought it up again; even a third time she repeated the operation.

By this time it was plain to lookers-on that her heart was not in her work, that she was merely "pretending" to build, that, in fact, she was in a "tiff," undoubtedly with her mate. But she went through all the motions so charming to see when done in earnest. She settled herself in the crotch as though it were a nest. She tried it this side and that, and she made great pretence of having definitely settled the matter. Meanwhile her mate, who had still a good deal of care of three dapper young robins in the evergreens (their first family), had apparently selected a heavier crotch in a better place, and he busied himself about that spot, not making any attempt to build, but merely showing his preference.

Madam would not look at him. Finally while she was absent, he came down to a vase on the lawn, a favorite perch of his, where he had sung away many a twilight hour, and began a very low, sweet song. It was alluring; hard indeed must be the heart that could resist it.

She did come, but she did not join him on the vase. She had another load of material, and flew at once to her chosen tree. He stopped singing and looked at her. She alighted and ran out on the branch as she had done before, and, as before, the material she had collected fell to the ground. Then she flirted herself over the crotch in a petulant way that tumbled off every scrap that had lodged there. Plainly she was "mad" and did not seriously intend to build there at all.

After this display she flew away, and her observer on the vase went to the ground where he could look through the passage she had taken. Presently the captious little dame returned with an empty beak, and alighted near him on the lawn. To our amazement he instantly ran away several feet, then paused. She advanced toward him, and he ran farther, keeping always a few feet from her. It actually appeared as if he were on the defensive.

This sort of performance went on for some time. Occasionally both were out of sight behind the low-growing evergreens, then both would return and go on as before, he never letting her get nearer to him than five or six feet. It was painful to see this bad state of things in our heretofore amiable couple, and we sorely regretted having torn down the nest.

It is one of the maddening things to the bird-student that he cannot keep his game always in sight. No matter how great the crisis in their lives, nor how absorbing his interest, a flit of the wings carries them out of sight in a moment. Then again they are such distressingly early risers. If the student tear himself away from his pillow before the sun shows his face, he will find bird-life in full blast. Before it is light enough to see well, their day of work and play is begun. We shall never thoroughly know the feathered folk till we rise at their uncanny hour and learn to fly!

Before we got the robin fairly in view again—probably in those tantalizing morning hours—their difficulties had straightened out, and building was going on seriously in a maple tree a little down the road, quite near the other, but out of sight from the veranda.

Two or three weeks passed in peace, and we hoped the robin troubles were over. Every day we saw the hard-working sire, followed around by his three young folk, as big as he was, calling and teasing for food.

Then one evening the robin treated us to a strange performance. He stood on the ground in the middle of the carriage way, crouched, so that he almost rested on the gravel, his head sunk between his shoulders, and looking as if he were at his last gasp. But he was uttering low notes, and we listened. It was a constant repetition of the queer unmusical sort of "que-e-e" with which many robins end their song. This is neither a trill nor a distinct note, but a sound as if the bird had tried to reach a high note and the voice had broken.

The bird repeated it again and again, and with varied inflections and movement. Plainly he was practising it. What could be his object? and why that unnatural attitude? Had he been crazed by his troubles, and was he a candidate for the lunatic asylum? or was he perchance a genius, evolving a new song for the robin tribe? Evidently he was bound to evolve something, for he practised without ceasing.

After awhile he moved a little so that his tail—still resting on the ground—was deflected to one side, in a very unnatural position, and there he stood motionless for half an hour or more, still constantly making the strange noises. All this time we had not been positive of his identity, but now he turned his head up as though addressing some divinity in the tree with his grotesque strains. He was not ten feet from us, and it was eight o'clock and perfectly light, so that we saw him distinctly. Just as we were concluding that some accident must have befallen him and we ought to go down to see, he suddenly straightened himself up on his legs, shook himself out, and sang out loud and clear his regular song. That made it certain that it was our friend of the maple tree, and we were fearful that his mate being at last settled and in her right mind, he had himself broken down. Our host, however, refused to take this desponding view. He insisted that the bird felt within him the stirrings of genius, and that he was founding a race of robins with a new song.

Certain it is that he kept up the strange practisings evening after evening, though never again on the ground. Madam, his spouse, sometimes came down and looked at him, as if to make up her mind whether he was simply unfortunate and to be pitied, or whether he were vicious in deliberately violating all robin traditions, and she ought to discipline him. Apparently she was unable to decide, for she returned to her undoubted duty, and he kept up his droll entertainment till the next instalment of his family came on to demand all his time and strength, and robin music ceased altogether.

At the end of July I left the scene of this robin eccentricity, but my comrade, who remained, heard so late as the middle of October, the same sort of performance going on among thick berry-bushes, at some distance from the house, and on starting up the bird she found it to be a robin.

Could it be the same bird? And shall we have a new sort of robin music next spring?

BIOLOGICAL NOTES FROM NEW ZEALAND.—II.

BY GEO. M. THOMSON, DUNEDIN, N. Z.

In a previous paper (*Science*, Vol. XX., p. 323), attention was draw to the fact that the plants of New Zealand are nearly destitute of all such structures as are correlated with the presence of mammalia. *A priori* this is what might have been expected in a country in which there were no indigenous mammals. Those plants which have defensive structures, such as spines, prickles, etc., and those whose seeds or fruits are fitted for adhering to the coats of passing animals belong in almost every case to species having a wide range outside of New Zealand, the inference being that the characters referred to have been developed outside the New Zealand region, and that such species have been introduced into these islands at a comparatively recent period.

Another interesting feature in the flora is the relation existing between the flowering plants and the various agencies which are necessary for fertilizing the blossoms. Visitors to these islands are usually struck with the prevailing dark hue of the evergreen vegetation and the apparent absence of flowers. Associated with this is a corresponding absence of conspicuous insects,—especially large Lepidoptera and Hymenoptera,—which are such active agents in this work in most other parts of the world. While it is true that there are a few species of flowering plants of exceptional beauty, such as *Clianthus puniceus* and the splendid white Clematis (*C. indivisa,*) yet the general verdict is correct that the flowers of the lowlands are chiefly inconspicuous. There is a beautiful flora on the mountains above the bush-line, i, e., from 3-5,000 feet, but with the exception of a very few striking species like *Ranunculus Lyallii*,—the so-called Mt. Cook Lily,—most of the flowers are only conspicuous by their aggregation; and nearly all such are white, with, in a few cases, a tinge of blue or lilac. The individual flowers of *Pygmœa*, *Helophyllum*, *Donatia*, etc., are small, but when one comes on hummocks of from one to three feet in diameter, with the flowering branches so densely crowded that the blossoms are in contact with one another, then such species may well be considered to be conspicuous. Some of the most singular of such aggregated flowers occur in the composite genus *Raoulia*. The individual plants are small, and are only a few inches in height, while their branches grow in dense masses, each ending in a small head of florets surrounded by pure white bracts, giving them a daisy-like appearance. When in flower on the mountain side, such masses are, when viewed at a distance, readily taken for sheep, and shepherds, unless provided with a good field-glass, may be, and often are, easily deceived; hence the popular name of Vegetable Sheep has been given to some of the species, especially to *R. mammillaris*.

Though conspicuous insects are rare, and the two orders already referred to are somewhat poorly represented, yet the number of flowering plants which depend on insects for fertilization is very considerable. Fully one-fourth of the total number are entomophilous, to judge by the fact that they are more or less conspicuous, and (or) are fragrant, and (or) possess nectar-glands; and of the hermaphrodite species which may or may not be insect-fertilised, about 37 per cent exhibit decided protandry, their stamens maturing before the pistils. This fact is almost always associated with insect-fertilization, while protogynous plants on the other hand are nearly always anemophilous or wind-fertilized.

The chief agents in fertilizing our indigenous flowers are flies and flower-haunting beetles. It is somewhat unfortunate from a biologist's point of view that the natural conditions have been very much obscured during the last twenty or thirty years by the introduction and very rapid increase of insectivorous birds. Many of the large hairy flies which used to be most abundant formerly are now comparatively rare, while the clearing and burning of the surface growth over great part of the country has thinned out the beetles and other insects to an amazing extent, not only by actually burning the individuals themselves and their eggs and larvæ, but also by destroying their breeding ground.

A few of the largest of the native flowers are fertilized by birds; the agents in this work being the Tui or Parson Bird, the Korimako or Bell Bird (Honey bird), the Kaka or large bush parrot, and the two or three species of parroquets. Fuchsias, Ratas (*Metrosideros*), Flax (*Phormium*), etc., seem to be quite dependent on the birds. In recent times the imported bees, both hive and humble (*Bombus*) have taken to visiting several of the native flowers.

A feature of interest, regarding which I have no adequate explanation to offer, is the occurrence of a very large proportion of unisexual flowers in the flora. About forty five per cent of the known flowering plants are unisexual, and of these a great number are diœcious. Several of these diœcious species are inconspicuous, such as the large liliaceous *Astelias*, and the Mistletoe (*Tupeia antarctica*), yet their flowers are most distinctly entomophilous, being fragrant and nectariferous. It is a still more remarkable fact that in the outlying islands of the Lord Auckland and Campbell groups, which are distinctly oceanic, in the sense that they are isolated from all larger masses of land by a deep ocean, there are several remarkably fine flowering plants, such as the Composites *Pleurophyllum speciosum* and *criniferum*, and *Celmisia vernicosa; Gentiana cerina* and the liliaceous *Anthericum Rossii*. The last-named is diœcious, and the others are most probably protandrous (judging only by the analogy of allied forms), but all have very beautiful and conspicuous flowers, and all are confined to these islands. Again in the Chatham Islands occurs the very fine for-get-me-not,—miscalled the Chatham Island Lily,—(*Myosotidium nobile*), retaining its beautiful pale-blue colors, as if evidently to attract insects. This plant, however, is self-fertile, but this characteristic must be an acquired one of comparatively late date. The flying insects of all these islands have never been investigated, yet it must be borne in mind that all the islands are of small size and are subject to strong winds; indeed the antarctic groups are swept by south west gales during considerable portions of the year. The question naturally arises, How are the flowers fertilized,—especially when diœcious as in *Anthericum?*

These are a few of the interesting points which botanists in New Zealand have met with during the few years since the insular flora began to be closely studied. The questions which arise are perhaps not so remarkable as those which the zoölogist meets with, but they bear on the same ground, and must be studied as closely in order that true views of the past biological history of these islands and of the geographical distribution of its organisms may be arrived at.

THE AMERICAN FOLK-LORE SOCIETY.

The fifth annual meeting of the American Folk-Lore Society was held in Montreal on Sept. 13th and 14th.

In the absence of Mr. H. Hale, of Clinton, Ontario, the president, and of Prof. Alcée Fortier, of New Orleans, the first vice-president, the task of presiding devolved upon Prof. J. P. Penhallow, of McGill University, Montreal.

The forenoon of the first day was devoted to the meeting of council, the report of which showed steady growth in membership and fair results in study, collection and contributions to the literature of the subject. The *Journal of American Folk-Lore* is now approaching the conclusion of its sixth volume, has proved both a stimulus to inquiry and a thesaurus of gathered data, curious and valuable. It is hoped that the scheme for the publication of special memoirs will shortly yield the first fruits of what may one day become a rich harvest. The members number more than six hundred, and there are flourishing local branches at New Orleans, Boston, Montreal and New York.

In the afternoon Professor Penhallow, as president of the Montreal Branch, delivered an address of welcome to the visiting members of the society. After touching on what had already been achieved in the working of the great northern field, he indicated several paths of folk-lore research that could be prosecuted best among the populations of Canada and called attention to many points of interest in the district of which Montreal was the centre.

Mr. W. W. Newell, general secretary of the society and editor of the *Journal*, expressed the pleasure that it afforded him to be again in Montreal. Hardly eighteen months ago he had shared in the organization of the local branch, and was naturally pleased to see it prospering. Coming direct from Chicago and the wondrous White City, which was "all mankind's epitome," it was a relief to survey a scene of repose and order and cleanliness, while still acknowledging the fascinations of the Fair, with its unique opportunities for seeing the world's diversities of speech, belief, costume and usage.

Professor Penhallow, having asked Mr. K. Boissevain to act as secretary, vacated the chair in favor of Prof. A. H. Chamberlain, of Clark University, Worcester, Mass.

Papers were then read on "Canadian Folk-Songs," by Mr. J. Reade of Montreal; on "Some Popular Oaths," by Mr. J. M. LeMoine, of Quebec, and by Prof. Heli Chatlain, of Loanda, Africa, on "Some Causes of the Retardation of Civilization in Africa." Mr. Chatlain's paper was the first-hand testimony of one who knew them intimately by years of residence and close association, to the superiority of the African race (the Bantu) physically and intellectually. He confessed that he had been educated to regard the negroes as the lowest in the scale of human creation, an unsuccessful attempt at man-making and a clog on the wheels of progress, and that the sooner it was made to give place to the European race the better it would be for the world. But his prejudice had gradually yielded to the logic of facts. He found natives of Africa, he said, not only on a par with Portuguese, German and English, when they were given the same advantages of education, but even in advance of them. He gave instances of such superiority in business, in the professions, in literature and science, from the German and Portuguese settlements in which he had resided. How then, their intellectual powers being thus unsurpassed, has it happened that the natives of Africa have been left so far behind not only by the white, but the yellow and, some say, even the red races? To this natural question M. Chatlain replies that, after nine years of personal experience and a much larger period of study, he had come to the conclusion that the causes for the stagnation of the African race were: (1) Seclusion; (2) The lack of a system of writing; (3) Polygamy and Matriarchy; (4) Slavery, and (5) The Fear of Witchcraft. Each of these points the essayist treated clearly from his own experience of the working of the system or defect which he condemned. Professor Chamberlain having thanked Mr. Chatlain for his valuable paper and invited discussion on it, some of the members questioned the correctness of Mr. Chatlain's estimate of the negro's intellect, and declined to accept a few examples of proficiency as the basis of so sweeping a theory. Prof. Chatlain replied to these criticisms, giving the reason for his belief, which was an actual acquaintance with the negroes of several of the Portuguese, German and British colonies.

In the evening a conversazione, which showed some novel features, was held in the Recital Hall, St. Catherine street, and was well attended. It consisted of illustrations of the music of Canadian folk-songs; of examples of Montreal street cries, repeated by phonograph, with lantern views of the criers exercising their callings. The musical part of the programme was in charge of Mr. H. C. St. Pierre, Q. C., and Mr. St. Pierre, and the cries, the success of which was largely due to Dr. W. G. Nichol, were in the care of Mr. Prowse. Ex-Mayor H. Beaugrand gave a lecture on pictographs, with lantern illustrations from La Hontan, etc. Altogether a pleasant and not uninstructive evening was spent.

On Thursday, the 14th, Professor Penhallow presiding, the reading of papers was continued. Mr. Newell treated of "The Study of Folk-Lore, Its Material and Objects." Having defined folk-lore, in its most comprehensive sense, which transcended the bounds set by the literal meaning of "folk" as virtually equivalent to the Latin "vulgus," with which it is allied, he went on to show the vast range of the science. Contemplating its mental and spiritual bearings, he suggested, as possibly acceptable generations hence, the term "palæo-noology" (analogous in formation to palæontology) to indicate the scientific history of mind through the long course of its development. Then, after surveying the field in the old world and the new he directed attention to the great mass of practically unknown folk-lore existing in Canada. Of this he urged the importance of a systematic quest.

Professor Chamberlain read (in part) a paper on "The Mythology of the Columbian Discovery," pointing out the far-reaching revival of Hellenized Celtic and other myths due to the disclosure of cis-Atlantic land four centuries ago. He referred to the Terrianoge (or land of perpetual youth), Valhalla, Avelion, St. Brendan's Voyage, Chicora, Cebola, Norumbega, Eldorado, as well as to the old Atlantic myth, the Garden of the Hesperides, the Insulæ Fortunatæ and other divagations of Greek and Roman mythology, and from passages in Shakespeare, his contemporaries and the writers that followed them down to a comparatively recent date, he showed how the renascence of these old-world stories influenced the minds of succeeding generations. He mentioned the Quetzalcoatl-St. Thomas hypothesis and other theories of white culture heroes visiting the western world; Madoc, the Amazons, the notion of Albino and negro Indians and other imaginary or monstrous beings.

Mr. Newell read an interesting paper by Mr. F. D. Berjeur on "Dextral and Sinistral Ceremonial Circuits," which treated of popular ideas as to the direction in which certain processes, culinary, industrial, medicinal and religious, should be conducted. A paper was also read on "Devil-Worshippers of India," by Dr. Thomas S. Bulmer, of Salt Lake City. Papers on the folk-lore of the Azorian Portuguese of New England, by Prof. W. R. Lang; a comparative study based on one of the Brer Rabbit cycle of folk-tales, by Professor Gerber; a paper on Irish folk-lore, by Mrs. E. Fowell Thompson, etc., were presented by the Secretary.

The Committee on Nominations made the following report:

President, Prof. Alcée Fortier, New Orleans; First Vice President, Capt. W. Matthews, U. S. A., Fort Wingate, N. M.; Second Vice President, Rev. J. Owen Dorsey, Bureau of Ethnology, Washington, D. C.; New Councillors, Professor Penhallow, Montreal; Prof, M. M. Curtis, Hudson, O.; Dr. A. H. Chamberlain, Worcester, Mass.; Curator, Stewart Culin, Philadelphia. The other officers are, W. W. Newell, Cambridge, Mass., Permanent Secretary; Prof. J. Walter Fewkes, Boston, Mass., Corresponding Secretary; Dr. John H. Houton, New York City, Treasurer. The committee proposed as honorary members the following: J. Lawrence Gomme, President of the English Folk-Lore Society; Prof. E. B. Tylor, LL.D., Superintendent Pitts-River's Museum, Oxford; H. Gaidoz, editor of *Melusine*, Paris; Paul Sebillot, Secretary of the Societe de Traditions Populaires, Paris; Dr. F. S. Krauss, Vienna; Jean Karlowitz, Warsaw; Dr. Kaarle Krohn, Helsingfors, Finland; Dr. Giuseppe Pitre, Palermo, Sicily; Prof. J. C. Coelho, University of Lisbon; John Batchelder, Hakodate, Japan; Horatio Hale, M. A., Clinton, Ont.; Major J. W. Powell, Director of the Geographical and Geological Survey and of the Bureau of Ethnology, Washington; Dr. D. G. Brinton, University of Pennsylvania, Philadelphia, Pa.

The foregoing nominations being submitted to the meeting, were approved. New Orleans was proposed as the next place of meeting, but no decision was arrived at.

R. V.

SOME REMARKS ON THE KINETIC THEORY OF GASES.*

BY S. TOLVER PRESTON, HAMBURG, GERMANY.

THE theorem that the velocities of the molecules of a gas vary "between zero and infinity" (between zero and a

*Reprinted, by request of the author, from the Philosophical Magazine for May, 1891.

velocity indefinitely great) would seem to give the idea that the velocities are enormously great sometimes.

But it would appear that there are distinct physical conditions tending to limit the velocities of the molecules of a gas (*i. e.*, the velocities capable of being acquired in the accidents of collision). First, there is the friction of the molecules in their passage through the æther. This must be considerable at high velocities, since meteoric dust is measureably retarded from this cause; and the relative friction or resistance to passage increases as the size of the body diminishes. So that probably by the known small size of molecules, the friction must be very great. Second, the resistance to passage is augmented from the fact that the molecule is in vibration (or some analogous motion about its centre of gravity) in the æther. The molecule is like a rough body then, stirring up the æther during its translatory motion, which must greatly augment the resistance to passage. That there is friction in the æther by the passage of molecules is also confirmed, as it seems, by the fact that waves of heat and light contain energy. For how should a vibrating molecule impart energy to the æther without friction or resistance? The resistance is, in fact, a measure of the energy imparted. It appears a question whether, if the amplitude of the vibration (or motion which stirs up the æther) of molecules were known, the friction or resistance could not be calculated therefrom. For we know the number of vibrations accurately by the spectroscope, and the energy imparted to the æther (or contained in the waves), by the thermopile. To deduce the resistance to passage represented by the act of vibrating or swinging, we only appear to require the amplitude of vibration then. Perhaps a limiting value for this could be approximately arrived at.

Another cause tending to reduce the velocity of translatory motion possible to the molecules of gases in the accidents of collision, consists obviously in the fact that the internal motion of the molecule (vibration, rotation, &c.) is proportional to the translatory velocity. So if a molecule attained an excessive translatory velocity, it would acquire an excessive vibration. This vibration would soon dissipate the energy in the æther in the form of waves of heat; and at the next succeeding collisions, the molecule would acquire a relatively slower translatory motion, as it could not retain the necessary vibratory motion (internal motion) which is the essential accompaniment of a very high translatory velocity. So, therefore, from all these causes, the speeds capable of being acquired by the molecules of gases in the accidents of their encounters, are probably moderate; and far less, perhaps, than might be inferred from the theorem that the velocities vary between zero and a velocity indefinitely great.

Referring to a letter received from the late Prof. Clerk Maxwell, I find that—"The number of molecules whose velocity is more than five times the mean velocity is an exceedingly small fraction of the whole number, less than one millionth. But if there were 10^{100} molecules, many millions of these would have velocities greater than five times the mean, and yet this would produce no appreciable effect on the whole mass."

It seems, then, from the above that the number of molecules attaining high speeds is relatively rare. But it appears none the less worth noting distinctly that an indefinitely great velocity would mean a velocity indefinitely greater than the speed of light even. Suppose a few molecules to attain extreme stellar velocities of say 200 miles per second; it is evident that the friction in the æther (appreciable in the case of meteoric dust) would commence to tell in reducing the velocity. And as for a molecule supposed to acquire the speed of light itself, the molecule would (in traversing the æther) resemble much a cannon ball moving through the air at the normal speed of the air-molecules themselves—about 1600 feet per second—where the resistance to passage is very considerable, so it seems that there are in practice physical conditions limiting the velocities attainable by the molecules of gases; the resistance to passage augmenting more than in proportion to the velocity. It is not at all as if those molecules were moving in empty space. A molecule, if assumed to acquire an infinite velocity, would certainly have to be assumed to possess an infinite energy. It may be questioned whether even the total energy of translatory motion of the stars in the collective universe is infinite in sum; if not, then a single molecule with a supposed infinite velocity would require to have a greater total energy than this. The expression "infinite velocity" apparently only comes into the mathematical calculations applicable to a gas, supposed infinite in extent. But in these calculations it seems tacitly to be supposed that the molecules are moving in empty space, which is, however, not a fact. On the contrary†, the molecules move in a resisting substance whose obstruction to motion increases in a high ratio with the velocity of the bodies which traverse the resisting substance.

†The late Prof. Clerk Maxwell arrived at some data as to the size, etc., of molecules. If we assume a hydrogen molecule to vibrate through an amplitude (say) two-thirds of its diameter at a certain temperature, we can obviously get the total distance traversed through the æther in one second by the molecule through its vibrations, i. e., the total distance equal to the sum of the amplitudes of all the vibrations of the molecule in one second. That is, add together all the amplitudes, and find what distance that would make in a straight line. The size of the molecule is taken from Maxwell. I find this distance to be about ninety miles, i. e., the molecule vibrates at the rate of ninety miles per second, by the above assumed amplitude of vibration in terms of dimensions of molecule (which seems quite possible). According to Maxwell, two million hydrogen molecules placed in a row would occupy a millimetre. Hence it appears practicable that molecules can vibrate at a greater rate than a planetary velocity, which may seem surprising to some, considering how small the dimensions of molecules are (and therefore their amplitudes of movement). The velocity of the earth in its orbit, for instance, is eighteen miles per second, as is known. The above comparatively high estimate for vibratory velocity of molecules (ninety miles per second, only a rough estimate, of course) may account rationally for the energy contained in the heat-waves of gases and other bodies, which (energy) is a measure of the friction or resistance opposed by the æther to the vibration or movement of a body in it. Calculations of this kind, although, of course, only approximate, may give us conceptions or ideas of the æther structure. If I had by me data as to the energy of the waves emitted by a gas (radiating power), it would obviously not be difficult to compute the static resistance opposed by the æther to the vibratory movement or swing of the molecule in it, in terms of the weight of the molecule, i. e., in terms of gravity. Whether we have here a swing of the molecule, a movement of rotation oscillatory in its nature, or any movement of a repeated kind, the same considerations evidently in principle apply. In the above computation, the wave length of a hydrogen molecule is taken to average one thirty-nine thousandth of an inch.

DISCOVERY OF ANOTHER ANCIENT ARGILLITE QUARRY IN THE DELAWARE VALLEY.

BY H. C. MERCER, DOYLESTOWN, PA.

On June 23, 1893, with the help of my assistant, Edward Frankenfield, I discovered another ancient argillite quarry, on the left bank of Neshaminy Creek, on the Warner farm, about three-quarters of a mile above the mouth of Mill or Labaska Creek (Bucks County, Pennsylvania).

No artificial hollows as at Gaddis Run have yet been found in the surrounding woods, but the rock here rising in a low cliff above the stream is argillite, and the water eating away the bank below it has revealed layers of chips, charcoal, large worked masses, pitted as if to split with the grain, pebble hammer stones and "turtle backs." A broken yellow jasper spear blade was found by Frankenfield 100 yards higher up the stream.

While the Gaddis Run quarry (noticed in *Science* of

June 9, 1893,) is twenty-five miles by the river above Trenton, these much smaller and less noticeable workings lie only fourteen miles inland east northeast from the site of the celebrated gravel discoveries.

Neshaminy Creek flows into the Delaware (right bank) about three miles below Bristol, (Bucks Co., Pa.,) and a walk to the quarries by following up the winding stream from the river would cover a distance of about twenty miles.

BOOK-REVIEWS.

Iowa Geological Survey, Volume I: First Annual Report, for 1892. By SAMUEL CALVIN, State Geologist, Des Moines, 1893. 472 p., 8vo. 10 plates and 26 figures.

IN addition to the administrative reports, the first report of the new survey contains seven papers, one of which is by the state geologist, three by the assistant state geologist C. R. Keyes, and the others by various members of the survey staff. The introductory paper, by Mr. Keyes, on the Geological Formations of Iowa is a summary of present knowledge of Iowa rocks. The author has here taken occasion to revise the classification of these formations to correspond with the progress made in their study in recent years with a very satisfactory result.

The Sioux quartzite is referred to as a doubtful element still in the geological section. The discovery of undoubted eruptive rock within these beds in southeastern Dakota by Culver and Hobbs, and in presumably the same beds in northwestern Iowa by the present survey, as set forth in fuller detail in Mr. S. W. Beyer's paper, is a matter of much interest and tends to add probability to the view entertained by Hayden that these rocks are much younger than commonly supposed.

The changes in nomenclature are much for the better, as for example, Oneata for Lower Magnesian; St. Croix for Potsdam; while in the Devonian the attempt to correlate the Iowa rocks with the New York section is abandoned. Prof. Calvin's work upon these formations has resulted in a four-fold division with names from places where the best sections are shown.

In the Lower Carboniferous, or Mississippian, the term Augusta is advocated for the terrane which Williams called the Osage, a name here shown to be inapplicable. We would differ with the author as to the advisability of dropping the term Warsaw as a sub-division of the Augusta in so far as concerns the rocks of Iowa, for though probably of limited development they present constant and easily recognized characters throughout the southeastern part of the state. An error occurs in the definition of the St. Louis limestone on page 72. The brecciated limestone is not the basal member, as asserted by the author, but in many sections along the Des Moines River there is shown to be from five to fifteen feet, or more, of a brown, quite regularly bedded magnesian limestome underneath the brecciated member and resting upon the arenaceous division of the Warsaw beds below.

In his discussion of the structure of the Coal Measures the author presents a valuable contribution to the literature of this subject, and advances conclusions acceptable alike for their simplicity and adherence to generally accepted principles of deposition.

The description of the Cretaceous formation is professedly taken from Professor Calvin's notes. Evidence is accumulating to show that these rocks have a much greater development in Iowa than heretofore considered. Three divisions are recognized and correlated with Hayden's Dakota, Fort Benton and Niobrara groups. The position of the Fort Dodge gypsum beds and the Nishuabotua sandstone are left undetermined.

In Mr. Beyer's paper there is given an account of the discovery in a deep well at Hull, Sioux County, Iowa, of quartz-porphyry—an eruptive rock, interstratified with sandstone. It occurred all the way from seven hundred and fifty-five feet down to twelve hundred and twenty feet, aggregating about one hundred and eighty-seven feet in thickness. To account for the presence of these rocks, the author advances two theories: (1) that they were due to secular outflow of lava upon the ocean bottom in Palæozoic times, (2) that they represent intrusive subterranean sheets from a Post-Carboniferous volcano. The latter view is considered the most probable. In the absence of evidence as to the age of the sandstones, however, we see no reason why a third view may not be entertained, viz., that they were secular overflows from a Post-Carboniferous volcano.

In Mr. H. F. Bain's paper we have an interesting and instructive discussion of the St. Louis limestone as found in Mahaska County, Iowa, while Mr. G. L. Housen's paper deals with the economic phases of some Niagara limestones.

An Annotated Catalogue of Minerals and a Bibliography of Iowa Geology by Mr. Keyes, complete the volume. The latter paper occupies more than half of the report and shows evidence of much care and painstaking labor, though a paper by the writer on the Keokuk limestone, published in the *American Journal of Science* for October, 1890, has evidently escaped the attention of the author.

The report has been printed from new and excellent type, the illustrations are exceptionally good, and altogether the volume in its make-up presents a pleasing contrast to many similar publications.

Typographical errors are not numerous, though some occur in prominent places, as, for examaple, in the word Survey on the title page, and in the words Tennessee and Territory on plate VI, though these can hardly be considered typographical. Errors appear also in the words Sandstone, p. 149, and Glacial, p. 139. A further criticism might be made on the lettering on the back of the volume, which scarcely seems in keeping with the pleasing effects of the text. But these are minor matters, and the survey and the state are to be congratulated upon the general excellence of their first report.

The Microscope: Its construction and management. Including Technique, Photo-micrography, and the Past and Future of the Microscope. By DR. HENRI VAN HEURCK, Professor of Botany and Director at the Antwerp Botanical Gardens; late President of the Belgian Microscopical Society; Hon. F. R. M. S. and New York M. S. English edition re-edited and augmented by the author from the fourth French edition, and translated by Wynne E. Baxter, F. R. M. S., F. G. S. With three plates and upwards of 250 illustrations. London, Crosby, Lockwood & Son, New York, D. Van Nostrand Co., 1893. 382 p., Roy. 8vo.

IT is due mainly to Professor Abbe, of Jena, that, during the past twenty years, a real science of "microscopy" has come into existence, the aim of which is to develop the theory of the objective and to enlarge its hitherto limited powers. In fact the practical application which he has made of the laws of diffraction is the basis of by far the greater part of all the advance which has recently been made in the use of the microscope for scientific purposes. His investigations have not only resulted in the production of lenses of unequalled delicacy and perfection but have imparted a new interest to the study of purely theoretical optics and have given rise to a large and growing literature of the subject. The increased importance thus conferred on this phase of the matter, together with the rapid broadening of the field of research, has led to a desirable separation between the study of the microscope as an instrument, and the study of the results of its employment.

Dr. Van Heurck's book is in the line of this change of relation. Its purpose is a survey of microscopical science from its technical, or, perhaps we should say, manipulative side. Although the language into which the work is translated is seldom wholly easy and natural, and occasionally becomes even awkward and obscure, the author may feel that, on the whole, his subject is presented to English readers in an interesting and attractive form. Dr. Van Heurck has long been known as a patient student of certain difficult problems in interpretation and a diligent cultivator of lines of microscopical work calling for expert skill in the handling of accessories, and it is in these directions that his book is strongest and most complete. We should hardly be justified, however, in characterizing his work as a symmetrical and systematic résumé of even the mechanical side of what is commonly known as microscopy. In truth it seems to us to be somewhat lacking in order and in equality of treatment of its various topics. It is in a measure a record of the author's own contributions to the progress of his favorite department of learning and therefore of necessity bears an evident personal stamp. The pride which he feels in his long experience and creditable achievements doubtless affects to some extent his sense of proportion, so that points to which he has himself happened to give particular attention are at times accorded what we may regard as a little undue prominence. Thus, for example, we are inclined to think too much space is given, and too much importance attached, to the subject of electrical illumination (pp.109-117), and that the praise bestowed upon the stand devised by Dr. Van Heurck (pp.224-232) is rather more unqualified than is appropriate to the circumstances under which it appears. One may reasonably question his assertion that "electrical incandescent illumination is superior to any other kind of illumination" for the microscope, and may well doubt whether he is fully justified in pronouncing his own stand "a perfect instrument." But these criticisms need not be taken as any disparagement of Dr. Van Heurck's authority on questions of construction and manipulation. In these matters, as we have already said, his knowledge and ability are generally conceded, and the novice will not go far astray in following his advice. If there is any fault to be found with his guidance it is likely to be that in places it is too profuse and painstaking. Thus, in common with most other writers of microscopical text-books, he appears to us unnecessarily lavish in the space devoted to the mere cataloguing of the instruments of many makers, which differ from one another mainly in pattern; and we feel disposed to ask whether a general description of the essential parts and qualities of a good stand, in each class, would not answer every purpose and enable the author to dispense with some pretty bad borrowed woodcuts. While on this subject, we venture to suggest, also, that much of the details under the heading "The Photographic Processes" might be omitted with profit, since they rehearse particulars which one may obtain in any manual of photography and which are not peculiar to photo-micrography. Indeed, some of the directions seem to be merely extracts from a general hand-book, as, for instance, where we are told (p. 272) that in development we shall get "first *the sky* and the high lights."

Beyond those portions which deal with the handling of the instrument and the preparation of specimens, this work undertakes to cover the theory, the history and the literature of the microscope. The chapter devoted to "Experiments on the Application of Dr. Abbe's Theory of Microscopic Vision" is a reproduction of Mr. J. W. Stephenson's very valuable paper presented to the Royal Microscopical Society in 1877, which Dr. Van Heurck has edited with a view to making it conform to the modifications which Prof. Abbe's views have since undergone. The chapter on "The Microscope in the Past and in the Future" is an abridgment of the Cantor Lectures of Mr. John Mayall, Jun., delivered in 1885. The chapter headed "The Microscopist's Library" is an incomplete list of periodicals and books not always up to date.

Notwithstanding the fact that the work before us is rather too sumptuous and bulky for everyday use by the student, it will doubtless prove a welcome addition to the library of the scientific amateur, and will perform a useful part in the promotion of interest in the instrument of which it treats.

LETTERS TO THE EDITOR.

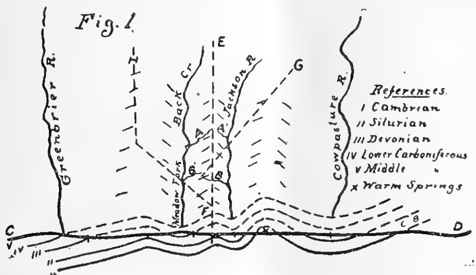
***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

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

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

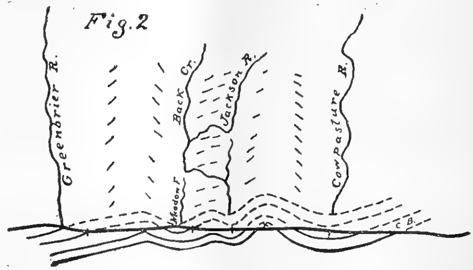
A Recapture From a River Pirate.

The Jackson River of Bath and Alleghany counties, Virginia, affords an interesting example of recapture of a



portion of a stream from "a river pirate." Last winter I directed the attention of Messrs. Charles Baskerville and R. H. Mitchell, students of the University of North Carolina, to the interesting problem of adjustment presented by this stream. A result of their investigation is given in the accompanying sketch maps.

Fig. 2 presents a map of the stream in its present relations, and a geological section of the country. In fig. 1 we have the streams at the beginning of their existence, just after the great permian deformation, occupying synclines upon the carboniferous rocks. The permian topography is represented by the dotted lines, the existing topography by the line C D. It is evident that in permian time Back Creek and Meadow Fork made a continuous stream, occupying a synclinal valley. The first capture was that of the headwaters of Jackson River by



tributary A of Back Creek, as the folds of permian time were higher to the east and died away westwardly. At a later date, probably at the time of the cretaceous tilting, when the hills sloping east became steeper, tributary B, of Jackson River, beheaded the pirate and recaptured her own waters. Collier Cobb.

Chapel Hill, N. C.

The Tin Ores of New South Wales and South Dakota.

The similarity of occurrence and of mineral aggregation of the tin ores of New South Wales and those of the Black Hills, South Dakota, is worthy of mention. The ores of both regions are extensively shown in the Mines and Mining Building, Chicago Exposition, and it would be difficult, if not impossible, for an ordinary observer to separate them according to locality if they should become mingled. The ores of both places occur in veins of the granitic type. Wm. P. Blake.

Shullsburg, Wis., Sept. 11, 1893.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

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For a rare chance to get a first-class microscopical outfit write for full particulars to box 125, Sellersville, Bucks Co., Pa.

For sale or exchange.—A fine collection of Lepidoptera, native and exotic. For particulars address Addison Ellsworth, Binghamton, N. Y., care Republican.

For sale or exchange for works on entomostraca, Wolle's "Desmids of the U.S.," Hentz "Spiders of the U. S.," The Amer. Entomologist & Botanist, Vol. 2, The Amer. Entomologist, Vol. 1, Harris's "Insects Injurious to Vegetation," colored plates, copy formerly owned by Townend Glover. C. Dwight Marsh, Ripon, Wis.

"The Conchologist: a Journal of Malacology," Vols. 1 and 2, with wood cuts and plates, value 12 | - will exchange for any works or pamphlets on American Slugs or Anatonry of American Fishes. W. E. Collinge, Mason College, Birmingham, England.

Wants.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc., etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

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SCIENCE

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SCIENCE

NEW YORK, OCTOBER 13, 1893.

THE AIR OF LARGE TOWNS.

BY G. H. BAILEY, D.SC., PH.D., THE OWENS COLLEGE, MANCHESTER, ENGLAND.

DURING the past three years a series of investigations have been in progress in England with a view to ascertain the composition of the air in populous districts under varying meteorological conditions. The Royal Society, the Royal Horticultural Society and the Manchester Field Naturalists have assisted the work by grants towards the cost of the requisite apparatus, and your readers may be interested in the results which have been obtained, although, of course, it is only possible to give a very brief summary of them. General experience has shown that evergreens cannot be grown in the heart of our larger cities and even the more hardy deciduous trees make little progress and sooner or later succumb. The sulphurous and other noxious vapors and the deposits of soot, hydrocarbons, etc., which form on the leaves are the chief agents in the destruction of plant-life.

Moreover, during periods of fog, when the air is surcharged with such impurities, the amount of sickness and the death-rate increase very considerably, especially in regard to diseases of the respiratory organs. The death-rate indeed from such diseases after foggy weather frequently increases to three-fold its normal value and is always exceptionally high in the densely populated districts.

Seeing that very few analyses of town air have been made embracing impurities such as sulphur in its various combinations and organic matter, attention was particularly devoted to these. And, indeed, setting aside the import of such forms of pollution from a sanitary point of view, the variations in sulphur compounds and organic matter may well be taken as means of differentiating between town and country air and of comparing together the condition of the atmosphere in different districts of a town. The method of procedure was to establish in London, Liverpool and Manchester and their suburbs a number of observing stations where determinations were periodically made of the composition of the air, of the character of the rain and snow and of the intensity of light. Comparative measurements were also at times made in country districts and in parts (such as Switzerland) where the air is of a great degree of purity.

From a very large number of observations I may summarize as follows:

(1) Country air and the air of the less populous parts of towns under the most favorable conditions show an amount of sulphur existing as sulphurous and sulphuric acid, etc., equivalent to not more than one volume of sulphurous acid per ten million volumes of air.

In populous districts this was found to rise to ten volumes *as a general average* in the Winter months and about five in the Summer. During dense fog such as occurs with tolerable frequency during the Winter, the amount recorded has been from thirty to fifty volumes. Whilst, therefore (as already found by previous observers), the carbonic acid gas during foggy weather is only about double that ordinarily occurring, the sulphur compounds accumulate so as to reach from twenty to fifty-fold their normal amount.

(2) Increase of a similar order was found to take place in the suspended organic matter of the air, and not only so, but the increase in amount, especially in closely crowded districts, was associated with a greater virulence.

A critical examination was also made of the nature of the deposits carried down during foggy weather, and as an instance I may give the composition of sample collected at Chelsea (London).

Carbon, - - -	39	per cent.
Hydrocarbons, - - -	12.3	"
Organic bases (pyradines), -	2.0	"
Sulphuric acid, - - -	4.3	"
Hydrochloric acid, - -	1.4	"
Ammonia, - - -	1.4	"
Metallic iron and magnetic oxide,	2.6	"
Other mineral matter, chiefly silica, and ferric oxide, -	31.2	"
Water - - -	not determined.	

(3) With regard to the prevalence of black fogs we are fortunate in having records (kept by Dalton) which indicate that in the earlier part of this century, Manchester, with a population at that time of about 120,000, had on an average about four or five dense fogs during the winter, whilst at the present day (with a population of half a million) we have dense fog lasting the whole day on twenty days or more and fogs of less density are experienced on forty or fifty days.

The number and nature of the fogs vary, of course, according to the season, but this may be taken as a general expression of the state of things now.

(4) Measurements of the extent to which the actinic rays are cut off by smoke and haze show that the central areas of our large towns suffer a very large diminution, amounting to a loss of from thirty-five to fifty per cent as compared with the suburbs. That these suburbs are themselves by no means removed from the influence of smoke is evidenced by the fact that under like conditions the values obtained at Torquay and at Grindelwald in Switzerland were three-fold and six-fold, respectively, of those given for the suburbs of London and Manchester. In foggy weather ninety-five per cent or more of the actinic rays are cut off.

(5) Determinations of the number of bacteria and moulds occurring in the air show that again in this respect, also, the contrast between town and country air is very marked indeed, and that in all such determinations due allowance must be made for the meteorological conditions prevailing at the time of experiment. The effect of impurities, such as sulphurous acid on micro-organisms, is also being studied.

Though in the previous paragraphs it has only been possible to deal in the most general manner with the results obtained, the remarks will, I hope, be sufficient to give point to a request that I should like to lay before your readers.

Smoke arising from the combustion of coal is undoubtedly the primary cause of the pollution of town air either directly or indirectly; directly in its contribution of sooty matters, hydrocarbons, sulphurous acid, etc., and indirectly in promoting a condition of the atmosphere in which free diffusion is very much interfered with and leading therefore to the accumulation of sewer gases and emanations from decaying refuse in the lower stratum of air. The substitution of gaseous fuel, though it may not get rid of fogs altogether, will doubtless mitigate in a very large measure their noxious character and in the era when lighting is done by electricity and heating by gas the whole aspect of our towns will be changed for the better. We have, however, no wide experience in this country to which to point as an object lesson in such a direction. In the United States gaseous fuel has been much more freely applied, and there are, I understand, instances in which coal has been almost entirely superseded by natural gas. If any of your contributors could say how far this is the case and give some idea of the effect which such a change has produced on the air of the locality and on the aspect of the town in question, a signal service would be rendered and a distinct advance would be made in the direction of banishing the fog demon once and for all.

THE UTICA SHALE IN STEPHENSON COUNTY, ILLINOIS.

BY OSCAR H. HERSHEY, FREEPORT, ILL.

In the various reports of the Illinois Geological Survey all the strata from the top of the Galena Limestone to the base of the Niagara have been classed together under the term Cincinnati Group. So far as northwestern Illinois is concerned this was probably the only classification possible from the limited data at hand. As a general thing only the upper half of the formation was seen in open section, as this is the only part ever quarried into, and natural sections of Cincinnati strata are rare in this region. But a few do exist in the southern and southwestern parts of Stephenson County, which show the lower strata of the shales, and from an examination of these, together with quarries and railway cuttings, the following section has been prepared:

Generalized section of the Cincinnati Group in Stephenson Co., Illinois.

Niagara Limestone.

Light brown, argillaceous, thin-bedded limestone, and white chert. Transition to Niagara, and counted with it. - - - - - - 10 ft.

1. Calcareo-argillaceous shales. Buff and gray, with irregular patches of blue. Generally unfossiliferous. - - - - - - 50 ft.
2. Light brown, crystalline, dolomite layers, and soft, yellowish shales. Fossils very abundant. - 15 ft.
3. Coarse-grained, calcareo-argillaceous shales. Light brown and red. Dark brown laminated shales alternating with lower layers. No fossils. - 20 ft.
4. Dark brown, argillaceous, finely laminated and very fissile shales. No fossils. - - 5 ft.
5. Same as above, except light brown in color. 3 ft.
6. Stratum containing much reddish-brown powdery iron oxide. - - - - - 6 in.
7. Yellow granular shale. - - - - 8 in.
8. Dark brown shales made up largely of comminuted shells. Fossils. - - - 4 ft.

Galena Limestone.

Since the remarkable discovery of oil and natural gas in the Trenton limestone of Ohio and Indiana, and the consequent discovery that the Utica shale of the New York section is present in the two states mentioned as a well-marked bed of dark brown shale, the writer has thought it probable that the Utica shale, *in its normal condition*, would be found to make up a part of the Cincinnati strata of northwestern Illinois.

Many of the "mounds" of western and southern Stephenson County are capped with a few feet of Niagara limestone, but the main body of the elevation is made up of the light colored shales or shaly limestones aggregating fifty feet in thickness, and numbered one in the section. This is certainly not Utica, but agrees pretty well in stratigraphic and lithologic conditions with the Hudson River shales, as developed in southern Ohio. The evidence is still stronger for the Hudson River age of the underlying fifteen feet of light colored shales containing numerous limestone layers, literally covered with fossils, which, so far as I know, are of typical Hudson River species.

The preceding strata are of a generally light color, but in No. 3 dark colors begin to appear. It is probable that wells drilled through the Cincinnati strata in this region would be reported as passing through sixty-five feet of light colored shales, then through twenty feet of gradually darkening beds, and finally about fourteen feet of dark brown shales. This agrees with well-section reports from Ohio, differing, however, in the thickness of the strata.

No. 3 is so coarse-grained as to resemble sandstone, but on dissolving the calcareous matter with acid the grains are found to be composed principally of clay. These gradually grow darker towards the base, and thin strata similar to No. 4 appear, alternating with the red sand-like shales. No. 4 is a very characteristic stratum of non-granular, finely laminated dark brown shale, weathering to a light blue color, and breaking into small flat pieces, as does the Utica shale of the Atlantic slope.

No. 5 is similar in constitution, but is somewhat lighter in color, weathering to buff. The thin stratum containing the bright colored powdery iron oxide appears to be made up largely of dark colored clay, but is not well exposed. The underlying yellow shale is similar to parts of No. 1, containing some irregular patches of blue, and seems out of place among these dark colored shales.

But now we come to the most remarkable of all—a four-foot stratum of dark brown shale, made up largely of fragments of small shells, irregular masses of iron disulphide, small rounded concretions of a slaty color, and dark brown or black mud. Only one variety of shell remains in an unfractured condition, and this is probably some species of Singula. These dark shales lie on a series of buff colored shaly limestones, also largely made up of comminuted shells, but which is undoubtedly the upper portion of the Galena Limestone.

The dark brown shales, Nos. 4 and 8 of the section and included lighter colored strata, are apparently stratigraphically and lithologically similar to the Utica shale as developed in Ohio and Indiana, and although this terrane in the latter state has been shown to thin rapidly towards the west, it is considered quite probable that it does not entirely disappear at least as far west as the region under discussion, viz., Stephenson County, Illinois.

While the lower thirteen or fourteen feet of the so-called Cincinnati shales of this region are considered to be truly of Utica age, the succeeding twenty feet of shales, No. 3 of the section, may be transition strata to the Hudson River shales, which certainly have set in in characteristic form by the time the base of No. 2 is reached.

There is evidence tending to show that some of the beds, especially Nos. 7 and 8, thin out and totally disappear in portions of the field, also that the dark brown laminated shales, No. 4, thin out towards the west and south, and perhaps the entire dark colored portion of the series disappears before reaching the Mississippi River. There seems to be an interesting field for future study in this portion of the Mississippi Valley, and some curious problems to solve.

This preliminary note is published in the hope that sections showing the lower portion of the Cincinnati shales in other counties of this and neighboring states will be reported for comparison in order to determine the boundaries of each distinct formation, and the changes which they undergo in passing from one region to another, which is absolutely necessary for the proper understanding of the early Silurian history of what is now northern Illinois.

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

ON THE SYSTEMATIC POSITION OF THE DIPTERA.

BY ALPHEUS S. PACKARD, PROVIDENCE, R. I.

WHILE, on the whole, the classification of the insects has become of late years placed on a more scientific basis, there is still some difference of opinion as to the systematic position of the Diptera, a few authors regarding the order as being the "highest," and entitled to stand at the head of the insect series.

Three important steps in the classification of insects have recently been taken. (1) The higher position given to those orders with a complete metamorphosis over those whose development is direct; no doubt the process of metamorphosis is an adaptive, secondary feature, and one not possessed by the more primitive, "lower" orders, such as the Orthoptera and Hemiptera, not to speak of the Synaptera (Thysanura, Cinura and Collembola). (2) The next great advance was the dismemberment of the Pseudoneuroptera into a number of distinct orders, and the separation of the metamorphic Neuroptera from the ametamorphic orders, with which they were formerly associated. (3) The last step in advance was the recognition of the inferior position of the Coleoptera compared with the Lepidoptera, Diptera, and Hymenoptera, the beetles having been during the first half of this century universally placed at the head of the insect class, for no other reason apparently than that they were the favorites of entomologists. Even now Brauer places them above the Lepidoptera and Diptera, but this seems to us to be erroneous, the beetles in their adult structure, especially the Staphylinidæ and Carabidæ being not so far removed from the Campodea-form type as the other metamorphic orders. With Brauer we regard the Staphylinidæ as being the most primitive group of beetles, and near them are the carnivorous groups (Cicindelidæ, Carabidæ, Dytiscidæ, and other Adephaga). Indeed, instead of considering the Rhyncophora as the "lowest," and therefore most primitive group, we are now strongly disposed to regard that group as neither "highest" or "lowest," but as the most highly modified of all beetles, and therefore as a whole probably more recently developed than the bulk of other Coleoptera. We would in classifying the Coleoptera begin with forms like the Carabidæ and Staphylinidæ, because their larvæ are the most primitive of coleopterous larvæ, *i. e.*, most campodea-shaped; and the imagines are more like their larvæ than any other beetles, differing mainly in having wings. Hence the Staphylinidæ and Adephaga are much nearer the ametamorphic Dermaptera and Orthoptera than the Rhyncophora, or beetles like the Lamellicorns, Cerambycidæ, Buprestidæ and other wood-boring Coleoptera, whose larvæ are either footless or tending to become so. Considering the larvæ alone is is evident that the carnivorous and leaf-eating forms, with flattened bodies, and well-developed legs, living a free, active life, neither boring into wood or other vegetable substances, but living under stones, or in the water, or on the surface of leaves—it is evident that these are the earliest forms, and that the larvæ of the Rhyncophora with their cylindrical, apodous bodies are much later, adaptive forms, which have lost their legs by disuse. The links connecting them with the earlier beetles are the Bruchidæ, for example, which in their first larval stages have long, well-developed legs, but which afterwards drop them, in adaptation to their weevil-like life in peas, beans, etc, The terms "high" and "low" are somewhat misleading, and for them should be substituted the expression more or less modified, or differentiated, recognizing the fact that the "lowest" forms are usually the more generalized and least differentiated, and especially least modified. When forms are rendered "low" by parasitism, they may be said to be degraded, retrograde or degenerate.

Now the same views will, we would suggest, apply in dealing with the Diptera. Compared with the Hymenoptera they are certainly more highly modified, but in a more or less special direction. The Hymenoptera are, it is now generally admitted, the most complicated or specialized and most differentiated group of insects; while, on the other hand, the Diptera appear to be a side branch of the insect tree, and both degenerate in important characters, and very much modified in others.

In the Hymenoptera there is a wonderful differentiation of the mouth-parts. Instead of the abolition of mandibles (Simulium excepted) and a reduction and modification of the maxillæ, which we witness in the Diptera, the three pairs of mouth-parts are not only very equably developed, but the parts are further elaborated with different portions specially adapted for special functions. In the Diptera the jaws are wanting, the maxillæ usually much reduced, while the labium is enormously developed and highly modified. The trunk of Hymenoptera is divided into three equally developed regions, while in Diptera the mesothoracic segment is enormously developed, the prothorax being aborted. In the Hymenoptera the wings of both pairs are well developed, in the Diptera the hinder pair have lost their function, as wings, and are greatly reduced and modified with the minute balancers, and more useful, perhaps, as organs of sense than of motion.

If we take into account, also, the differentiation of the brain of Hymenoptera, their social life, nest-building habits, the differentiation of the sexes, their high intelligence and very complete metamorphosis, the Hymenoptera certainly overtop the flies.

The larvæ of Hymenoptera are, except those of the saw-flies, very much modified, but the simplest more modified ones, those of ants, wasps and bees, are less modified than the maggots of the Muscidæ and allied groups.

And here we should, as in the case of the Coleoptera, reverse the usual arrangement of the Diptera. It is evident that a form like Simulium, in which the jaws are retained (though microscopic and in a rudimentary or reduced condition), is nearer what must have been the original, primitive Diptera than any other forms, usually in our systems placed above this genus. For a stronger reason the mosquito, especially the female, with its equably developed mouth-parts, the mandibles and maxillæ being well developed, is nearest to what was probably the earliest, most primitive, most equably differentiated Diptera. In classifying the Diptera, therefore, we should prefer to begin with the Culicidæ as being the most primitive unmodified Diptera, and end with the house-flies and their allies, together with the sheeptick (Pupipara) as being the most highly modified, and the last to appear, of the dipterous series.

In the Hymenoptera there is nothing of this kind, we do not have entire groups of this order which have become so reduced, degenerate and modified, largely the result of parasitic life, as in the flies. The Hymenoptera are a normal blossoming or branching out of the topmost portion of the tree of insect life, while we should regard the Diptera as a degenerate, retrograde, downfallen branch.

If we look at the larvæ of Diptera we shall see that the most perfectly developed or highly differentiated forms are those of mosquitoes, black flies and the Tipulidæ, etc., (Encephala); then we pass on to a series in which the body becomes more and more maggot-like, the head being so reduced in the Muscidæ (in the old sense) that it is difficult to make out the homologies of the antennæ and parts of the mouth. The internal organs, as the tracheæ, share in this alteration and extreme modification of parts, adapting the maggot for its parasitic or otherwise peculiar mode of life and surroundings. Indeed, below the families embraced in the Orthorapha (Culicidæ, Simulidæ, etc.), the great group of Diptera now consists of very degenerate, highly modified forms.

Now under what canons of taxonomy are we to act in considering what forms are "high" and what are "low," unless we take into account the facts we have considered? It seems to us that the few entomologists and other naturalists who advocate placing the Diptera at the head of the insect series, disregard the fact that the processes of degeneration, reduction, with specialization in limited directions, and of adaptation to unusual modes of life, their habits being, in many groups, parasitic, or partially so, have brought about a modification of larval and adult structure, such as we do not find in any of the other larger orders of insects.

It seems to savor somewhat of a violation of the principles of classification, which in these days is based not only on comparative anatomy, but on morphology, paleontological history, and the facts of adaptation to changed conditions of existence, to give the highest rank to a group in which disuse of certain parts leading to degeneration, and the modification of other parts adapting them for quite peculiar uses, are so marked. And it is this wonderful amount and variety of modification and adaptation to this or that mode of life which makes the group one of such striking interest to the philosophic student. We see how much at the mercy of the environment the group has been exposed, and this is especially striking when we compare the Diptera with the great group of Lepidoptera, where there is a striking persistence and fixity of structural features, both in larva and imago, as well as in the modes of life, and the nature of the food.

BOOK-REVIEWS.

British Locomotives, their History, Construction and Modern Development. By C. J. Cooke. Whittaker & Co., London and New York, 1893. 376 p. 12mo. $2.00.

An interesting and very instructive account of the rise and progress of the locomotive, especially in Great Britain, including important details of construction and dimensions, as well as performance. It is written in a sufficiently popular style to be readable by any one having an interest in its subject, and is yet sufficiently technical to satisfy the specialist desiring information in relation to the proportions and the work, or even the general plans, of locomotives, old and new, including, of course, the now familiar "compound engine." The book is addressed, and most suitably, to all who take an intelligent interest in the working of the locomotive and of railways, and to practical railway mechanics as well. It is written by an employe of the London and Northwestern Railway, and is therefore reliable and accurate; its illustrations are from working drawings, and are supplied by the great locomotive designers of the United Kingdom, and are, therefore, valuable to the professional, as well as useful to the casual, reader. The early history of the engine, of the struggles in which George Stephenson and his contemporaries engaged to make steam a successful railway motor, and the later account of the modern compound engine are likely to prove most interesting to the average reader; but no one should omit the careful perusal of the last chapter, on the duties of the locomotive engine-driver, in which he will find much to impress him with the wonderful combination of courage, skill, intelligence, foresight, knowledge and readiness, in times of emergency, which is demanded of that humble and rarely appreciated craftsman.

Negative Beneficence and Positive Beneficence: Being Parts V and VI of the Principles of Ethics. By Herbert Spencer. New York, D. Appleton & Co. 12mo. $1.25.

This volume completes Mr. Spencer's ethical treatise, so that all who wish to know the final views of the philosopher of evolution on questions of conduct and duty are now enabled to do so. In the opening chapter Mr. Spencer draws a very sharp distinction between beneficence and justice, as he understands these terms, and then proceeds to show that beneficence has two forms, the positive and the negative. He then discusses various forms of negative beneficence, which consist in refraining from acts that would be injurious to others or to society at large, and afterwards those forms of positive beneficence which he deems most important. He confines himself almost entirely to private and industrial life, and we look in vain in these pages for any recognition of that beneficence that shows itself in advancing human knowledge and human virtue. Indeed, with the exception of certain passages in which the author's excessive individualism shows itself, the book is of a commonplace character; and whoever takes it up with the expectation of having his moral ideas clarified or his moral sentiments quickened and elevated, will be disappointed.

But what is more remarkable is that Mr. Spencer, as we learn from his preface, is himself disappointed; for, after congratulating himself on the completion of the work, he says:

"My satisfaction is somewhat dashed by the thought that these new parts fall short of expectation. The doctrine of evolution has not furnished guidance to the extent I had hoped. Most of the conclusions drawn empirically, are such as right feelings, enlightened by cultivated intelligence, have already sufficed to establish. Beyond certain general sanctions indirectly referred to in the verification, there are only here and there, and more especially in the closing chapters, conclusions evolutionary in origin that are additional to, or different from, those which are current." For our part, we can see no connection between the law of evolution as propounded by Mr. Spencer and the moral law; and we cannot perceive that he has shown the existence of such a connection. Both in this volume and in the preceding one on "Justice" evolutionary principles are brought in only occasionally and incidentally; and, when they are brought in, they are generally irrelevant to the discussion. Indeed, how can the study of a merely natural process like evolution teach us what we ought to do? How can we even know whether evolution itself makes for good or for ill unless we already have a moral ideal by which to judge its results? We fear that those who have been expecting evolutionism to furnish a guide of life will have to look in some other direction.

The Religion of Science. By Dr. Paul Carus. Chicago, The Open Court Pub. Co. 12mo. paper.

In this work Dr. Carus has undertaken to expound what he believes is to be the religion of the future. He disbelieves, as our readers doubtless know, in anything supernatural, but holds fast to the ethical teachings of Christianity and to the Christian ideal of character. It is true that he uses the Divine name frequently; but he expressly teaches that God is not a person, but merely the eternal and all-controlling power in nature. Sometimes he uses the language of pantheism; yet he insists that his doctrine is not pantheism but, as he terms it, entheism. He denies the existence of the soul as a distinct entity, and of course disbelieves in its immortality. Everything in the old religions that savors of the supernatural he regards as mythology, and maintains that it is destined to pass away, leaving nothing but the moral teachings and aspirations bequeathed to us by the prophets of old. He holds his creed with unquestioning faith, and is rather intolerant of those who still cling to the ancient creeds. "What the Roman church claims to be," he says, "the religion of science is. The religion of science is the catholic and orthodox religion." He is rather bitter against the churches for their adherence to forms and ceremonies and to what he deems erroneous doctrines, and declares that their religion is radically different from that of Christ himself. With much that he says we fully agree, and we respect the moral earnestness with which he discusses the problems of life and duty; but we are not prepared to follow him in rejecting theism, and we have much less confidence than he seems to have in some of the doctrines and criticisms that are put forth in the name of science. Yet we have read his book with interest, and we cordially echo the sentiment he expresses that "blessed is he who trusts in the truth, who hearkens to its behests, and leads a life in which obedience to truth is exemplified."

The work here noticed is to be published with others in a series entitled "The Religion of Science Library," the volumes of which will be issued bi-monthly in paper covers at 25 cents each or $1.50 a year. The first number in the series, which bears the date of September, 1893, is a reissue of Max Müller's "Three Introductory Lectures on the Science of Thought," which was noticed in these columns when it first appeared some years ago; and other works new and old will follow in due season.

Heat. By Mark R. Wright. Longmans, Green & Co., N. Y., 1893, 336 p. 12 mo. $1.50.

This text-book of heat and thermodynamics is a well-planned and well-executed work, suitable for the classes of high schools and colleges in which an elementary course has been given, as introductory to this subject, in the usual first lessons in physics. It is made up with a view to use in connection with instruction in the laboratory, as well as in the lecture-room, and contains an excellent outline of the thermal and thermodynamic principles constituting the modern science of heat, illustrated by experiment, and enforced by numerical examples, not numerous but very carefully selected, and in every case apposite to the text. The book is, in physics, what Remsen's text-book is in chemistry, a well-prepared outline of the theory and experimental method of exposition of the science. The units employed are both the British and the metric, the C. G. S. systems. Students about to take up the applications of such principles in the advanced classes of colleges, and especially of the technical schools, will find this an excellent preparatory course. In the introduction to the chapters on thermodynamics, the work of Rumford and of Davy is given proper place, and more credit is given the former than is usual in earlier treatises. Regnault's work is quite fully discussed, and the algebraic treatment of the thermodynamics of gases and vapors is unusually satisfactory. The book is printed on heavy paper, in excellent type, is well illustrated, and well bound.

Outlines of Pedagogics. By Professor W. Rein. Translated by C. C. and Ida J. Van Liew. London, Swan Sonnenschein & Co.; Syracuse, N. Y., C. W. Bardeen. 12mo. $1.25.

This work, by the director of the pedagogical seminary at the University of Jena, is written from the standpoint of the Herbartian philosophy, and is designed to set forth Herbart's theory of education as developed and modified by his disciples. The work, like so many others that come to us from Germany, is not always easy to understand; and, though it contains much that is sound and suggestive, we doubt if it will effect any radical change either in the theory or in the practice of English and American educators. The whole book is written from a German point of view and with reference to German needs; and the division of the school system according to the German division of society into classes is assumed as something final. The parts of the book that are likely to be most interesting to American teachers are those in which the author discusses the end and aim of education and the subjects and method of instruction. The end at which all education ought to be directed is, in Professor Rein's opinion, the formation of character; and he lays such exclusive stress upon the training of the will that he almost forgets that the intellect and the feelings are entitled to consideration on their own account. Nor do we find that he offers anything essentially new as to the means of forming character; for, though he devotes considerable space to the subject, he suggests nothing to the purpose except the study of good literature and the employment of teachers of excellent character. With regard to instruction Professor Rein holds opinions somewhat different from any now prevalent in this country; and, while we cannot endorse all that he says on the subject, there is much in it that is suggestive. He holds, with Comte and others, that the education of the child ought to follow the steps that the race has taken in its historical development; but, notwithstanding the authorities that may be cited in support of this theory, we venture to think that an education based upon it would be ill adapted to the requirements of a civilized age. The importance of the right method in teaching is a subject on which the author lays great stress, and practical teachers can hardly fail to get from him some hints and warnings that will be useful. The book will serve a good purpose in drawing renewed attention to the importance of moral training, and also by presenting certain aspects of educational work that have not been generally discussed in America.

Birds of Michigan. By A. J. Cook. Bulletin No 94, Michigan Agricultural College. 148p. illus. 8vo.

This Bulletin marks something of a departure in the work of experiment stations. Most of the bulletins issued under the auspices of these wards of the Government are devoted to purely agricultural topics such as feeding of pigs or cows, dairying, planting potatoes, cultivation of corn, value of fertilizers, spraying for fungous or insect diseases and kindred subjects. Some few of the stations publish work of a high character, work which shows some originality. It must be confessed, however, that too much of the station work is of a very poor quality. Often it is a rehash of some previously issued experiments, in which the errors are copied along with the correct statments. Often it consists of descriptions of hastily made experiments which lead to no practical results; or else it may be an account of some experiment which had been tried with negative results years before, but of which the author of the "new" experiment was totally ignorant. The present publication does not lay claim to any profound scientific knowledge or pretend to herald any new discoveries. It is a catalogue of the species of birds known to occur in Michigan, compiled from various published and unpublished data, with notes on localities and other items. There are 332 species recorded. Abstracts are given of bird and game laws, and a bibliography of over 200 references adds to the value of the whole. The illustrations, mostly taken from Coues's "Key to North American Birds," will prove of great assistance to those using the Bulletin in the state. J. F. J.

LIQUID AND SOLID AIR.

BY JOHN S. MCKAY, PACKER INSTITUTE, BROOKLYN, N. Y.

The physical state, or condition, of a body is entirely incidental and never dependent upon any inherent property. The same substance may be solid in one zone and liquid or gaseous in another. According to the kinetic theory, the different states of matter are only different modes of molecular motion and any change of state is the result of the absorption or liberation of energy. By the addition of sufficient heat energy all solids and liquids become gases, and by withdrawing such energy all gases may be reduced to the liquid or solid state. It is probable that at the temperature of absolute zero (–273°C.) there would be neither solid nor fluid, but that if matter still continued to manifest itself to our senses, it would be in a different physical form from anything now known. It is certain that there could be no gases at that temperature, since molecular motion is essential to the idea of gaseity. From recent experiments it seems probable that all gases, under ordinary atmospheric pressure, would become liquid or solid before reaching absolute zero. It is a well-known fact that after a gas has been cooled below its critical temperature it may be reduced to the liquid state by the aid of external pressure. Until a few years ago oxygen, hydrogen, nitrogen, air, and a few other gases had never been reduced to their critical temperatures and hence could not be liquefied. Air had been compressed until it was denser than water without any trace of liquefaction. And so these gases were called permanent or incoercible gases. But in 1879 Cailletet of Paris and Pictet of Geneva, working independently and by somewhat different methods, succeeded in reaching the critical temperature of some of these gases and by great pressure reduced them to the liquid form. Since then all known gases have been liquefied and the old distinction of permanent and coercible gases has been effaced.

The critical temperature, or absolute boiling point, of these gases is very low, being –140°C. for oxygen, –146° C. for nitrogen, and –240° C. for hydrogen. This low temperature is obtained by evaporating in vacuo liquid NO, CO_2, SO_2, or some other substance whose critical temperature is comparatively high and which is therefore easily liquefied. As yet hydrogen has been liquefied only in small quantities by allowing it to expand suddenly when at a low temperature and highly compressed. In some remarkable experiments before the Royal Society of London during the past year Prof. Dewar made use of liquid ethylene to secure the low temperature necessary to liquefy air and oxygen. By means of three concentric vessels, the outer one containing liquid nitrous oxide and the next one liquid ethylene, both being connected with powerful vacuum pumps to increase the evaporation, he secured so low a temperature in the inner vessel that oxygen, nitrogen and air were liquefied in large quantities with comparatively little pressure. By causing a vacuum to act upon a large tube containing liquid oxygen, a temperature of –210° C. was produced. A small empty test-tube inserted into the boiling oxygen was so cold that the air of the room at ordinary pressure condensed and trickled down its sides. By evaporating liquid nitrogen in a vacuum, a temperature of –225° C. was reached, at which point nitrogen became solid.

Liquid oxygen when first formed is milky in appearance, owing to the presence of some impurity which may be removed by passing it through ordinary filter paper. When pure it is of a pale blue color, which, however, is not due, as some have thought, to the presence of liquid ozone, which is of a dark blue color. Liquid oxygen is a non-conductor of electricity but is strongly magnetic. It may be lifted from a cup by presenting the poles of a strong electro-magnet. It seems to have very slight chemical activity, since it will extinguish a lighted match and has no action on a piece of phosphorus dropped into it. It is well known that the A and B lines of the solar spectrum are due to oxygen, and, from recent experiments on the top of Mount Blanc, it is thought that they are largely if not wholly due to the oxygen in the earth's atmosphere. Prof. Dewar showed that these lines come out very strong when liquid oxygen is interposed in the path of the rays from an electric lamp.

Liquid air is at first somewhat opalescent, owing probably to solid particles of carbon dioxide. It may be cleared by filtering or by standing for a few minutes, when the particles rise and disappear. When any of these liquefied gases are placed in an ordinary glass vessel they boil vigorously and soon disappear owing to the heat obtained from the vessel and surrounding objects. In a vessel made of rock salt they take the spheroidal form and last much longer, but Prof. Dewar found that they could be kept longest in vessels with double walls with high vacua between them. A small bulb filled with liquid air and protected by a vacuum would require an hour and a half to boil away, five times as long as it could be kept in an ordinary vessel. Liquid air has the same high insulating power as oxygen but is less magnetic. Its magnetic power is evidently due to the oxygen, since liquid nitrogen is not magnetic. When the oxygen is attracted by a magnet it draws the inert nitrogen along with it without being separated, but if a sponge or ball of cotton be saturated with liquid oxygen and presented to a magnet the liquid will be drawn out of the meshes and cling to the magnet until it evaporates. The normal boiling point of nitrogen is about eight degrees below that of oxygen, so that the two substances may be separated by distillation, the nitrogan boiling off first and leaving the oxygen. But when air is being liquefied the nitrogen does not come down first, as might be expected, but the two condense together at a temperature about midway between their respective boiling points.

All the liquefied gases except oxygen and hydrogen have been frozen by self-evaporation in a vacuum. By evaporating liquid air in a vessel surrounded by liquid oxygen, Prof. Dewar succeeded in reducing the air to a clear, transparent solid. It has not yet been determined whether the oxygen of the mixture is really frozen or merely entangled among the particles of solid nitrogen in some such way as rose water in cold cream, or water in the solid gelatin of calves' foot jelly. Although pure oxygen has never been frozen it is possible that when mixed with nitrogen its freezing point is raised so that the two solidify together.

One of the interesting things connected with these recent experiments in the liquefaction of gases is the fact that it enables us to produce a lower temperature than ever before. We are slowly creeping down toward the absolute zero and the possible solution of the mysteries connected with the nature and constitution of matter. Is it not possible that we may yet be able to separate matter from energy and thus form some conception of matter pure and simple? When the molecules cease to vibrate what would be the state or condition of matter? Would it still manifest itself to the senses? If so, what properties would it retain, what new ones acquire?

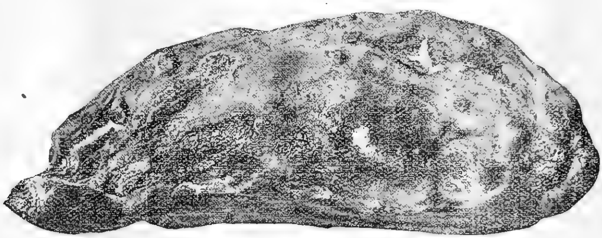
FUNGI PARASITIC INDICATE KINSHIP.

BY BYRON D. HALSTED, RUTGERS COLLEGE, NEW BRUNSWICK N. J.

It is difficult in a short title to express the leading thought of this paper. Possibly it may be expressed as follows: Fungi, when strictly parasitic, as a rule, infest either a single species, or, if more than one, the hosts are not distantly related. It is therefore to these species that have a wider range than a single sort of host that attention is called at this time. Please bear in mind that the word "strictly" is employed in the statement of the proposition. Therefore it may be possible to draw something of a conclusion from instances when a fungus grows with almost equal ease upon a wide range of substances. But this is a matter of secondary importance at the present time. For our purpose a fungus may be considered strictly parasitic when it attacks what appears to be perfectly healthy tissue, as the leaf or stem of a plant in the full flush of its vitality. Let some instances be cited to make the fact emphatic. Three years ago there was an outbreak of trouble in a Jersey cranberry bog. The leaves, blossoms and young stems became distorted with numerous minute galls, due to a microscopic fungus (*Synchytrium Vaccinii*, Th.). The cranberry being a bog plant is under water for a part of the year and the shore plants bordering the bog are likewise submerged for some time as well. The fungus discharges its spores into the water, and they are carried to all parts of the bog and the overflowed neighboring land during the spring floods. During the investigation of the cranberry gall trouble the shore plants came under notice, and it was found that several kinds of them were attacked in a way similar to the cranberry. Two interesting facts were obtained in the investigation; first, that the cranberry gall fungus attacked the shore plants up to a certain well-defined line. If the shrub was low it would bear galls throughout, but a high one had them only upon the lower leaves and branches. In short the gall fungus attacked those parts only that were under water at the time of the floods when the spores were being disseminated in the water. The second interesting fact was that all of the shore plants showing signs of infection were all members of the same family (*encacaiae*) with the cranberry. The hosts among themselves are widely different in general appearance, and it was remarkable how dissimilar were the galls upon these various species. Upon the white alder, for example, the galls were large and hairy; while upon the wintergreen and sheep laurel they were smooth. But without going into the details of minute structure there seems no doubt that all forms are of the same species, and while the water must have been well charged with the germs and bathed for days or weeks the entire vegetation of the submerged shore, none but the members of the heath family were affected.

The demonstration is quite complete that the presence of this fungus indicates kinship among the host plants. So strong is this that should a new host be found for this gall fungus the first thought would be that the victim is a member of the heath family of plants.

Similar instances might be mentioned in connection with other fungi, and that almost without number. In the case of fungi attacking fruit the circumstances are somewhat different and this sends us back to the word "strictly" in the original proposition. It may be contended with considerable show of reason that a fruit, particularly if it is nearing maturity, is not altogether alive, but instead, having become the receptacle of various substances to facilitate the dissemination of the maturing seeds within, is passing from the condition of a highly vitalized portion of the plant to a passive condition that will soon be on the verge of decay. This being the case, it is not exceptional to the rule when it is found that a mould that grows upon the tomato may thrive equally well upon the peach or plum. The soft tissue in each case is similar and the fungus does not need to overcome the resisting force, peculiar to each species, that is associated with the living portions of the plant. Should the fungus in question grow also upon the otherwise healthy foliage of the tomato, peach and plum, the question would be different. It would be a true parasite that was able and willing to flourish upon the fresh products of life, namely, the fruit. The leaf fungi, as a matter of fact, are widely different from those of the peach and plum, and those of the cherry and plum, for example, are often identical; and the hosts are within the same small group.



Passing to a small group of closely related plants; namely, the cucurbits, it is interesting to note how wide spread some of the fungi are preying upon the species. Thus the water melon is frequently badly affected with an anthracnose, which growing in the rind of the maturing fruit causes it to become full of decayed pits. The muskmelon suffers from the same fungus but the texture of the skin of its fruit is so different that the decay might be considered as not the same as the one of the watermelon. A third member of the same family, namely the cucumber, is not exempt from the same enemy, as the accompanying engraving will indicate. This illustration is from a photograph of one of a bushel or more of equally bad specimens met with at a market place. The cucumber being of a softer texture is much more quickly destroyed than the muskmelon or watermelon.

This anthracnose (*Colletstrichum lagenarum* (Pass) E and H.) thrives upon the foliage of the three named hosts causing a leaf blight. It is a true parasite and assists in indicating the close kinship of the hosts.

—"Our Own Birds," by Wm. L. Bailey, published by J. B. Lippincott Company, is an excellent manual for those who wish to become familiar with the common birds of this country. It contains a number of half-tone full-page illustrations, with others in the text.

CURRENT NOTES ON ANTHROPOLOGY.—XXXIII.

(*Edited by D. G. Brinton, M. D., LL.D., D. Sc.*)

OLD SKULLS, AND PERHAPS THAT OF SOPHOKLES.

LAST year, before the British Association, some skulls were exhibited and described, which were of men said to have lived six thousand years ago. They were brought by Mr. Flinders Petrie from Egypt and taken from tombs of the third or fourth dynasty. They were rather dolichocephalic,—about 75,—and from the general relations of the skeleton, belonged to a somewhat undersized race, with negroid characteristics. They may have been slaves, or a mixed strain.

Not less interesting is the description recently given by Professor Virchow, in the Proceedings of the Royal Prussian Academy of Berlin, of some Greek skulls of ancient date. One of them, from Menidi, was believed by its finder to be that of the great classical dramatist, Sophokles. The oldest were from Mykenæ, Spata and Nauplia and were prehistoric. They were all slightly brachycephalic, orthognathic, with the nose rather broad.

The grave of Sophokles is believed, on a certain amount of literary evidence, to have been on the road from Acharnai, the modern Menidi, to Dekeleia, about 11 stadia from the latter. Following this clue, the archæologist Münter opened a tumulus at this point, and came upon a a stone wall enclosing four sarcophagi, two of marble, each containing a male skeleton. One of these was of a very old man, with a cane by his side, an alabaster vase, etc.

Sophokles died at ninety years of age in B. C. 406, so the character of skull, as that of a very old man, corresponds. It proves on examination to be long, 73.3, with a remarkable irregularity between the right and left hemispheres, the left temporal suture nearly obliterated, the forehead broad, the face narrow and high and slightly prognathic, the nose narrow, the capacity low, 1340 c. c. Possibly it is the very skull of the old poet.

THE AFRICAN PIGMIES.

FEW anthropological questions are of so much importance as that of the African pigmies. In the last number of the *Zeitschrift fur Ethnologie*, Mr. Stuhlmann, who had been with Emin Bey, gives some interesting facts about them. Their height is about 1.25 metres, the head round, the nose flat, the face very prognathic, the hair spiral-woolly and brown, the skin light-brown with an undertone of reddish-yellow. The beard is scant, a light, down-like hair covers the whole body, and the effluvium of the person is penetrating and disagreeable. They differ very much, therefore, from the true negro race.

Mentally, they are cunning, cruel, with keen senses and thieving propensities. They use small bows with poisoned arrows, live in slight temporary shelters, and wear light clothing of leaves or strings. Their language has no numerals, and is related to that of the Wambuba tribes. They appear to have no ornaments, nor to tattoo the skin, but they occasionally bore two holes in the upper lip. They seem to have some religious notions, as they are careful to bury the dead in a particular position. They have some form of marriage, and cannibalism is not general.

Stuhlman does not believe that these dwarfs came about through degeneration, but that they are the relics of a peculiar variety of the human species which once extended over Africa and probably reached into Asia. They have many childish traits, their skeltons are in various respects undeveloped, and they may be regarded as a race of human beings which has undergone permanent arrest of evolution.

This was also the conclusion to which H. Panckow arrives, in an article published in the Journal of the Berlin Gesellschaft für Erdkunde, in 1892. He claims that an original diversity is proved by such traits as the color of the skin, the development of the gluteal muscles, the smallness of the hands and feet, etc.

It must be said, however, that these peculiarities are only somewhat greater in degree than those of the Bushmen, the Lapps and other diminutive races; and it is not yet necessary to demand for the African dwarfs an origin different from that of the rest of the human race.

FURTHER ON THE "HITTITE" QUESTION.

IN *Science*, May 26, I referred to some recent studies about the so-called "Hittites," or rather, once so-called, but so no longer. The Hittites, as real people, are now determined to have been a Semitic tribe, speaking a dialect not remote from that of Phenicia. They are not the people who wrote the mysterious inscriptions in syllabic characters which still so puzzle the antiquary. These are now referred to as "Pseudo-Hittites," or as before said, Chaldi.

Their language is still unclassified. M. Menant claimed to have fixed two of its words, *kar*, a fortress; and *sarou*, king; but these are Semitic, so he was off the track. Professor Sayce, in the edition of his "Comparative Philology," published last year, asserts that it "belongs to the Alarodian group of speech, of which the Georgian may be taken as an example;" but Professor Sayce's identifications and translations (?) of the Vannic inscriptions have been treated with small respect by the latest students.

Among such students may be named Lehman, Belck and Nikolsky. The last-mentioned has printed twenty-two Chaldic inscriptions with attempted renderings, in the Proceedings of the Moscow Archæological Society. It is claimed that these determine positively several words, such as *ainei*, stone; *inili*, palace; *tiini*, named; and a few more. One of the most important inscriptions is that of the styla of Rusas at Toprakaleh, which promises to yield its contents to persistent study.

The present tendency seems to be to regard the Chaldi as of Indo-Germanic origin, probably immigrants from Europe, and their culture largely self-developed. Lehmann, in the last number of the *Zeitschrift fur Ethnologie*, gives the credit of first broaching this theory to Professor Puchstein.

ANTHROPOLOGY IN ROME.

IT IS a gratifying evidence of the scientific activity which prevails in Italy, that in June last the Societa Romana di Antropologia was founded at Rome, with a membership of about one hundred founders. The aim of the Society is broad, anthropology being understood in its true sense as the science of man in all departments of his nature. The announcement therefore states that the publications of the Society will embrace papers of the physical traits of man; his origin and pre-history; his ancient migrations; arts and social relations; the ethnic influence of peoples on each other; collective and ethnic psychology and pathology; and the physical and mental education of tribes and nations. The Society is not confined to citizens of Rome, but intends to include those interested in these studies throughout Italy.

The President is Professor Giuseppe Sergi, the distinguished teacher of anthropology in the University of Rome; and among the members are Dr. Angelo Colini, docent in ethnology in the same University; Dr. L. Moschen, docent in anthropology; Dr. E. Raseri, docent in statistical demography, in the same; Dr. E. Brizio, professor of archæology in the University of Bologna; Dr. V. Grossi, docent in American ethnology in the University of Genoa; Dr. A. Zuccarelli, professor of criminal anthropology in the University of Naples; Dr. Riccardi, docent of anthropology in the University of Modena; and many others whose works have secured them well-earned titles of honor.

Professor Sergi himself is one of the most industrious of anthropologists. Within the present year I have seen from his pen a learned essay on the "Principles and Methods of Classifying the Human Race," by craniological forms; a "Systematic Catalogue of the Varieties of Man found in Russia;" and a Report on the Anthropological Congress in Moscow in 1892. No doubt under his active guidance the new society will have a prosperous career.

NOTES OF SOME EXPERIMENTS ON THE HOUSE-FLY.*

BY JOHN B. SMITH, SC. D., RUTGERS COLLEGE, NEW BRUNSWICK, N. J.

Insects, in some circumstances, exhibit a tenacity of life which is extremely surprising. They will stand a great deal of mutilation, apparently without manifesting pain, and will get along quite comfortably on a minimum allowance of wings and legs

The house-fly is about as common an insect as we have, and I was led recently to try some experiments with a view to locate, as nearly as might be, the seat of life—or rather the controlling nerve centre, for life exists in each cell—in this insect. A number of flies were captured and decapitated. This process, of course, severed not only the nervous cord, and separated the brain from the rest of the body, but it cut as well the alimentary canal, and the main blood vessel, the Aorta. Flies so treated lived from ten to sixteen hours. They had, of course, lost all sense of direction; but had not lost the use of any of their limbs. When they were touched with the point of a needle they would walk away; but always in a straight line, and without attempting to avoid any obstacle that might have been in the way; if the annoyance was more than a little, they would attempt to fly. As in the former case, they were unable to direct themselves, and as soon as they met with an obstacle would rest quietly until again irritated. So long as they were left undisturbed they remained at rest, or if a pencil was presented to them between the fore legs, they would crawl up for a short distance, and again rest quietly. In such cases it was rather difficult to make them loosen their hold; they would cling tightly, and would not, if they could avoid it, loosen their grasp until something else was presented to them to which they could attach themselves. There seemed to be a realization that something was wrong, and occasionally the front legs would pass over the place where the head ought to be; but there was not at any time what could be considered as a manifestation of pain.

From another set of flies the abdomen was cut. This severed the nervous cord, the heart and the digestive system including in the latter almost all save the œsophagus. These insects lived for from six to ten hours, and for a large portion of the time they were active, flying about and running, and in fact behaving themselves like insects that were in all respects normal. As in the other case there seemed to be no active manifestation of pain. For a short time, say half a hour after the abdomen was severed, the insects were constantly extending and withdrawing the proboscis, evidently realizing that something was wrong, in that connection. At no time was there any interference with the power of motion, either of the legs or wings, and in fact it was impossible to see any difference between their case and those of perfectly normal flies, under the same circumstances and confined with them.

*Read before Section F., at the Madison meeting of the A. A. A. S.

Perhaps a few words of explanation concerning the gross anatomy of the fly may not be entirely out of place in order that my experiments may be better understood. Insects, generally, have only a single blood vessel, extending the full length of the body, and lying just beneath the dorsum, or upper surface. The digestive system occupies a large portion of the abdomen, and the central part of the thorax. The nervous system extends the full length of the body, in the form of a double cord, on which there are at somewhat irregular intervals enlargements or ganglia, and it lies on the floor of the body, just above the under surface. That ganglion which is situated in the head, is called the brain. We have seen that severing the brain from the rest of the body did not kill the insect; the severed head in no case showed any power of motion in any of its parts, no matter what means were taken to excite it. So long as the head was left attached to the body, even if the abdomen had been cut off, all the mouth parts, and the antennæ could be readily excited and made to move. No insect that had been mutilated by cutting off the abdomen could be induced to feed or attempt feeding. Cutting off all that part of the nervous cord that was situated in the abdomen produced no interference with the powers of motion. From another set of specimens both head and abdomen were removed, leaving only the thorax with its appendages; how much life remained in the abdomen it was impossible to say, since it contained no appendages that could be readily stimulated. The head, as already mentioned, soon died; but the thorax alone retained life for more than six hours, and these fragments of insects could be readily made to walk, although rarely could they be induced to make use of the wings. Yet if one were held up by the legs with forceps, the wings would be used in trying to escape, and would buzz as lively as if the insect was in full possession of all faculties.

From a number of other specimens the abdomen and that portion of the thorax containing the hind legs were removed. These specimens lived for from five to six hours. Both fore and middle legs remained perfectly active, and the mouth parts were readily stimulated. The hind legs could not be stimulated even where that portion of the thorax bearing them remained attached to the abdomen.

Another set of specimens was treated as were those last mentioned, except that the head also was removed. Here two-thirds of the thorax, containing two pairs of legs, remained alive quite as long as when the head was attached to it; the presence or absence of the brain appearing to make no difference. Other specimens were taken and these were cut in two between the first and second pairs of legs. The anterior p rt, containing the head and fore legs, remained alive for from four to five hours, although of course incapable of moving about. It was easy to induce an insect so treated to extend its tongue, and indeed this was done quite frequently by the insect even without stimulation. The legs were passed at intervals over the front of the head and there was no difficulty in exciting them to motion by merely touching with a needle or any similar instrument. That part of the insect containing the middle and hind legs and the abdomen seemed devoid of active life, and it was impossible to induce these structures, or the wings, to move, within a very few moments after the operation. Another set of specimens was treated exactly as those last mentioned save that here the head also was cut off. In this case the fragment of the thorax containing the front legs lived for three hours, while the other portions of the insect were apparently dead a very few minutes after the operation. An insect cut in half through the prothorax died almost immediately, neither portion responding to such stimuli as I employed, more than a very few moments after.

To test this matter in another way, I captured a number of specimens and with finely pointed scissors cut the heart or dorsal vessel, at the middle of the thorax. These insects lived nearly twenty-four hours, proving that the circulation of blood is not dependent entirely upon the heart, and, in fact, these insects lived as long as others which were not mutilated at all, and were kept in the same dish merely as a check. I could not find that these insects differed in their actions in any way from those that were perfectly normal. Another set of specimens was treated by cutting not only through the heart, but also through the œsophagus where it passed through the prothorax, and thus the alimentary canal was severed. Specimens so treated died somewhat sooner than did the previous lot, although they also lived nearly twelve hours. It was also noticed of these insects that the tongue or proboscis was frequently extended and retracted as in the case of those insects in which the abdomen was removed. Another set of specimens was treated by cutting the nervous cord in the thorax just behind the posterior legs. This resulted in the paralysis of the hind legs, but did not appear to affect either the fore and middle legs or the wings. Where the cord was cut between the middle and hind legs, exactly the same result was obtained. Cutting the cord between the fore and middle legs, close to the middle legs, however, resulted in the paralysis of everything behind the fore legs, and of the wings as well; although the insect lived for more than six hours afterward, both the head and its appendages and the fore legs responding readily to stimulation. As a result of this crude series of experiments, it would seem that the vital point, or, better, the controlling nerve centre in flies, is located in that large ganglion situated in the prothorax, just above the fore legs, and that so long as this remains intact, the insect retains power of motion and evidences active life. Severing or piercing this ganglion, killed the insect at once.

LETTERS TO THE EDITOR.

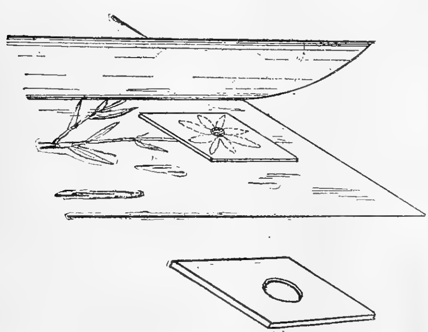
***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

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

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

Herbarium Specimens.

In preparing specimens of the Composite family for the herbarium, it is difficult to press the flower so that the



rays will not wilter, owing to the fact that the head keeps the paper from pressing upon the rays. The following device has been used by the writer with much success in preventing this difficulty, and might be useful to students who are collecting autumn flowers.

A small square or disk is cut from blotting paper and a hole is cut in its centre, a little larger than the head of the flower. If, in pressing, this disk be put over the flower, allowing the head to come up through the hole in the centre, the rays can be pressed out flat. The thickness of the disk should vary accordingly as the head is thick or thin.

Richard H. Rich.

Beverly, Mass., Sept. 25, 1893.

Minnesota Mounds.

I read with considerable surprise Mr. Schneider's article entitled "Notes on Some Minnesota Mounds" in *Science* of Sept. 1, and I at once felt it to be my painful duty to correct some gross misrepresentations. I happened to be working in the same party with Mr. Schneider when he made the valuable discoveries which he describes and therefore am in a position to criticize his statements.

It is true that we found a number of Indian burial-grounds in the vicinity of Mille Lacs. Most of these were still in use, or had been so until quite recently. In two which I assisted in opening we found some decidedly modern relics, e. g., a U. S. ten cent piece used as a bangle, a glass butter-dish, a rubber comb and a jack-knife such as any Yankee boy might carry. These graves were arranged in rows and were usually covered with superstructures of wood, which might be compared to dog-kennels. We found a few graves rather older than the above, and which were covered with low mounds of earth, but even here there were traces of wooden stakes, which gave evidence of their recent origin. As to the mound at Lake Warren, which Mr. Schneider dug into, I confess that I was not present when it was opened. I have, however, seen the "relics" which were collected from it—in fact I am in a position to see them whenever I wish. Without stopping to question whether the age, sex and stature of the individuals could be accurately determined from the very fragmentary skeletons which he found, I would say that the bones are nearly as well preserved as some which we found in one of the covered graves above described and which I know to have not been buried more than twenty-five years. It is hardly necessary to point out the absurdity of supposing that a hole in which the "roughness of the sides" was still apparent could have been filled for several hundred years.

The specimens of pottery which he describes are merely fragments of baked clay utensils of the roughest sort, just such as all the American Indians manufactured before they obtained iron kettles from the whites.

In fact there is not the least evidence that any of these bones or relics are of any great age or that they belong to any race older than the Indians which inhabit this district at present. They are of no more value to the archæologist than bones dug from the nearest cemetery.

Francis B. Sumner.

University of Minnesota, Minneapolis, Minn., Sept. 23, 1893.

Origin of Gold.

I would like to draw attention to a somewhat fallacious deduction which appeared in an interesting little article, "The Origin of Gold," in your issue of Sept. 1st. The author mentions the remarkable fact that, in a part of Southern India, quartz-veins, though traversing both gneiss and belts of rocks, which have been termed the Dharwar, are gold-bearing in the Dharwar only, and are never productive in the gneiss. Mr. Lake then argues: "It is clear, therefore, that the gold cannot have been introduced into the reefs from below, for in that case there would be no difference in that respect between the reefs in the gneiss and the reefs in the Dharwar."

Without wishing to uphold the ascensional theory of the formation of lodes, it may be pointed out that the gold may have risen from below in both the veins in the gneiss and those in the Dharwar, but that owing to unfavorable conditions in connection with the gneiss (*e. g.*, absence of a precipitant) the gold has not been deposited in the veins in the gneiss. The case does not stand alone. The influence of the "country" on the productiveness of veins is a phenomenon well known and appreciated by mining engineers, and both the ascensional and the lateral secretion theories can be adapted to explain it.

It would have been interesting if Mr. Lake had given details of those observations which led him to believe that the schists of the district were lava-flows.

L. H. LINNELL COOKE.

Glasgow, Scotland, Sept. 22nd, 1893.

A PHONETIC ORTHOGRAPHY.

A NEW system of English orthography is proposed in *Science* (July 21), by Prof. J. I. D. Hinds, of Lebanon, Tenn., and endorsed with slight alterations (*Science*, August 25), by Frederick Krafft, of Jersey City Heights.

Reform, not revolution, in English orthography, is very desirable; but reform, to be successful, must be in accord with the spirit of the English language; it must also be attempted a little at a time. "Great reforms progress slowly."

Any system proposed that is simply phonetic must fail for the following reasons: (1) Our alphabet is inadequate; (2) the people of different sections or schools pronounce many words differently; (3) everyone would spell according to his own ideas of pronunciation, and there would be no standard. The fact that Prof. Hinds and Mr. Krafft, who attempt to agree, differ is evidence of that.

People are not all born with perfect audition and perfect powers of enunciation. These are matters largely of education. Perfection in these two particulars is very rare. In order that two persons pronounce all their words alike they must be of the same race or family and have the same teachers all their lives.

In America, where the most perfect English is said to be spoken, there are great differences in some of the vowel sounds in the different sections of the country. In any neighborhood in the west the same differences may be found according to the section from which the different neighbors came. The state or section from which a man came may usually be determined by his speech.

Without laying claim to perfection myself, but only to show the differences of pronunciation in different parts of the country, I wish to point out discrepancies in the pronunciation of these two gentlemen:

Professor Hinds offers *aa* to represent the sound of *a* in *father*, and then gives as an example, *waaz* for *was*. That will not do. The sound of *a* in *was* is very nearly the sound of *o* in *dog*. It would better be represented *woz*. Again he gives *waac* for *watch*. The vowel sound in that word is identical with the sound of *o* in *not*, and should be represented by *woc* (wotch). Mr. Krafft's representation *wac*, as if to rhyme with *thatch*, is worse yet, and is probably a typographical error. *Laaf* will do for *laugh*, if he likes it; but is it not rather pedantic and affected? Better the sound of *a* in *last*. Let the following nonsense sentence be read aloud and the differences of sound of the vowel *a* noted: "Father laughed hard after Fanny's hairless watch-dog was last granted fat."

Laj in *villaj* will not do. *Villaje* is much pleasanter. The sound of *a* in *village* is as *a* in *mate*, shortened, unaccented, and rendered somewhat obscure, less in time than short *e* in *edge* and less open in quality.

With in Prof. Hinds's extract may be an oversight. *Widh* would be better.

O'r should be *oer*, — long sound of *o*, not short.

Murmur will do; but *yondur, sobur and hurd* will hardly do. They have not the sound of *u* in *up*. *Dher* by Prof. Hinds, in the same line, may do for *their* if the word is not emphatic; otherwise his *dhair* (probably *dhaer* was intended) for *there*, and Dr. Krafft's *thare* for both *there* and *their* would be better. Yonder, sober and herd, ordinary spelling, would be less liable to be mispronounced, considering that *e* followed by *r* differs from *e* in *met*.

Puel, skuel and *lues* are very bad, when *ue* is given to represent *u* in *rule*. Undoubtedly Prof. Hinds meant that *ue* should represent *oo* in *tool*. *U* in *rule* is the same as *u* in *mule*, except that in *mule* a *y* is distinctly sounded before the *u*, and in *rule* the *y* is indistinctly sounded on account of the preceding *r*. *Pool, school* and *loose* are much different from *pule, skule* and *luce*.

U in *playful* should not be sounded as *u* in *up*. It should be as *u* in *pull*. For this sound Professor Hinds proposes *oo*. The notation then should be *plaefool*.

Weind should be *wind* (short sound of *i*). The word does not rhyme with *mind* and should not be so read. The rhymes are allowable, not perfect.

Some words in the extract are lengthened, defeating one of the objects sought, as *waaz, vaekant, konfyuzhun*. Again, dissylables are written with a single vowel, as *sofnd, gabbld*.

Thus all this is designed to show the impracticability of a phonetic system. The one proposed is as good as any. No phonetic system will meet all requirements for the reasons here given: (1) Differences of pronunciation among different people, and (2) defective alphabet, necessitating the use of digraphs to represent some of the simple sounds.

Speaking of digraphs, how can we limit a simple sound to single digraph when our language now furnishes us with such a vast variety of digraphs, trigraphs, and even polygraphs to represent the different sounds? Take, for instance, the sound of *a* in *mate*. We are by no means limited to the twenty combinations presented by Professor Hinds. We must spell plague with *a-ue*. Naas with *aa*, Mælar with *æ*, and Græme with *æ-e*. Mr. Baehr is particular that we shall spell his name with *aeh*; while another Bhaer is equally strenuous that *hae* shall go into his name. Brahe, however, gives the letters another twist (ahe); while Mahlon drops the *e* entirely. *Praise* is stronger than *pain* in having a final *e*; and the Des Plaines River requires a final *es* to complete its orthography. Marais des Cygnes will have *ais*, Aisne *ais* and *e* final, while *chaise* (colloquially "shay") except the deacon's one-hoss one, carries the polygraph *aise*. We must remember to spell Basle with *as-e*, Naix and Morlaix with *aix*, Carhaix with *haix*, La Haye with *haye*, and Aux Cayes (O. K.) with *ayes*.

The Ray family is large and diverse. One branch clings to Rhe, showing *he;* another adds an *a* making it Rhea (*hea*); while a third, the Scotch Rea, omits the *h*. A gentleman of Ireland, who long ago built a castle (Castlereagh) near Lough Neagh (Nay), with his descendants, to this day spell the name Reagh with *eagh*; and a pioneer of the west, Mr. Reaugh (Ray), with probably a still more ancient lineage, delights in *eaugh*. The name of the late governor (Seay) of Oklahoma requires *eay* for its correct make-up; Payne wants *ay-e*, Cheyne *ey-e*, and a certain Swedish American, Hoeland, prefers *oe* in his name. When fully Americanized he will probably be Hayland.

Among words from the French, employé and resumé require an accented *e;* protegée one accented and one plain *e*, and the plural, pronounced similarly, an *s* additional, thus *ees*. Feting requires a plain *e*, crepe two, *e-e*, melee double *ee*, entrees *ees*, orgeat *eat*, entremets *ets*, mobilier *er*, and chef d'œuvre *ef* or *efs*, according to whether the word is singular or plural. We will distinguish crochet with *et*, crocheted with *ete*, pique (the cloth) with *ue*, croquet with *uet*, and roqueted with *uete*. We must not forget that Duchesne requires *es-e*, Duquesne *ues-e*, Niquée *uee*, Torquay *uay*, and Queyrac *uey*. Chassez ("sashay") completes our French list with *ez*.

We spell seine with *ei-e*, eigne with *eig-e*, and eyot (ait) with *eyo*. We must remember rhaphe with *ha*, Thame in England with *ha-e*, heir with *hei*, and renaigue with *ai-ue*. As an oddity we find quegh, which ought to be obsolete, troubled with *egh* or *aich* (quaich), quoits ("quaits" in the country) has *oi*. Theys (tay) goes with *heys*, and old Mr. Trew (Tray) is ever faithful to *ew* in his name.

But why prolong this exhibit? The reader is already exhausted, and the chapter is not yet complete. Suffice it to say there are nearly one hundred different ways of representing the long sound of *a*, many of them in patronymics and names of places that need to be pronounced by English-speaking people. For other vowel sounds there is an equally extensive variety of representatives.

All this would, perforce, show the necessity of a reform in spelling—phonetic reform, if need be; but, on the other hand, the letters of a word are the earmarks, if you please, that indicate ownership—that show the philologic derivation and history of a word. Phonetic reform could never touch the majority of irregularities in spelling and retain any intelligence in the word. Therefore, with all its faults, our heterographic orthography is preferable to any homographic orthography that can be devised with our present alphabet.

What we can do is this: Drop some of our redundant letters as *me* from programme, *ue* from catalogue, etc.; final *e* from strychnine, etc., when the preceding vowel is short; *a* from plead (pled), past tense and pp., and similar words; change *ph* to *f*, as in sulfur. There is plenty of scope for good work in this direction, and such work will finally become permanent. We would become accustomed to these words, as to dock-tailed sheep, and prefer them.

B. B. SMYTH.

Topeka, Kansas.

FEIGNED DEATH IN SNAKES.

FOR a long time I have desired information from others about a common trick of the ordinary "blowing viper," or "spreadhead snake" (*Heterodon*, in several species). I have observed that such animals when much worried, or slightly hurt, will frequently feign death. This habit has doubtless been often reported before, but I do not recall having seen definite mention of it in print but once. Several months ago, some one writing about snakes in a daily newspaper, alluded to this matter, and gave, as an explanation, the off-hand statement that the snake became frightened and "fainted from fear." That this is not the explanation will, I think, appear from what I have noted about several cases that came under my own observation.

The first time I ever noticed this behavior on the part of a snake was when I was a child. At that time I was one day crossing a field accompanied by an old negro man and a small dog. The dog found a common black "spread-head," and, without actually taking hold of it, began to worry it by running around it, snapping at it and barking. Anxious to save my friend, the dog, from what I supposed was deadly peril, I struck the snake with the only weapon quickly available, a small whip I carried in my hand. The snake immediately ejected a toad it had recently swallowed, then appeared to bite itself in the side, and promptly turned on its back and stiffened (but did not become stretched straight out) and lay perfectly still. There was not even a wiggle in its tail when pinched. Believing, as I then did, that all snakes were venomous, I supposed this one had killed himself; and remarking that he "seemed dead enough," I was on the point of leaving him. But the old negro said, "Oh no! If you leave them when they bite themselves, then their mates come along and lick the bite, and they come to." So I mashed the snake's head in a way that no amount of licking would ever heal. The old man evidently knew, by some means, that snakes which appeared thus to commit suicide would recover, and knowing no real explanation of why they should he invented one. Therein he followed the example of more eminent men than himself.

Before I again noticed such action by a snake I had studied zoölogy a little and had learned that the spread-head was said to be non-venomous. Consequently when I next met one, and began to cultivate a closer acquaintance with him, and he seemed after a time to kill himself, I was much surprised, and began to investigate his mouth, to see if he did not have poison fangs after all. He, as they all do, had turned himself on his back and was lying rigid in that position. In the course of my investigation I turned him over, "right side up," again. He was playing dead so earnestly that he could not lie in so lifelike a position, but immediately turned himself on his back again. Then, of course, I knew that a snake which was *too dead* to stay in the position in which I placed him, was *too alive* to be very badly hurt. I determined to watch him. Accordingly I removed him to a smooth, clear place and then withdrew to a little distance to quietly watch developments. In about fifteen minutes the snake cautiously raised his head and two or three inches of his body and looked around. If he saw me, he failed to recognize me, and in a few seconds had turned himself over and was making off. When I advanced quickly towards him he redoubled his efforts to escape, but was easily captured. He did not, at that time, again "play 'possum."

Often since then I have watched them go through this pretended suicide. Usually when becoming active again, they behave like the one just described; but occasionally when they find themselves overtaken as they are making off, they will again at once feign death. Sometimes while "playing dead," if one is sharply pricked with a needle or otherwise acutely stimulated, he will promptly resume his interest in surrounding things and either show fight or try to escape.

Occasionally when I have spoken to friends about this matter and they have shown a disposition to regard my statements as "snake stories," in the popular sense of that expression, I have been fortunate enough to get hold of a spread-head and show them what I had before described to them.

It is usually easy to provoke a *Heterodon, niger, H. platyrhinus*, or *H. simus* into feigning death by striking him with small twigs or a good bunch of broom straw, or by a little brisk handling. I wish some one else would examine these snakes with reference to this habit and report his conclusions. I think "fainting from fear" is shown to be wrong by the snake's refusing to stay in any other position than "flat on his back."

Recently while conversing with a friend about this matter, he suggested that perhaps the rattlesnakes wnich are so often provoked into biting themselves and then seeming to die, were also acting a deceptive part in order to escape. This seems more probable as one noted experimenter, Dr. S. Weir Mitchell, says that the injection of rattlesnake's venom into the snake's own circulation does not appear to cause any special inconvenience to the snake.

I would be glad to get some further information on this subject. J. W. KILPATRICK.

Fayette, Mo., Sept. 23, 1893.

ELECTRICAL COOKING.

THE elaborate argument of R. A. F., in a recent number of *Science*, in favor of the economy of cooking by electricity will hardly convince the practical man. While witnessing the interesting exhibit of electrical heating apparatus at the World's Fair I asked the attendant in charge "What current is required for your flatirons?" "Four amperes and one hundred volts," he replied. "Eight cents an hour," I said to myself, "at ordinary lighting prices. That is far more than the household coal costs for all purposes." Even at half the lighting rates such heating costs too much for ordinary use.

W. C. S.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

For Exchange.—Books and pamphlets on geology, ornithology, conchology, and entomology. State what line and I will send list. I want Odonota from any locality, and literature on this group. M. J. Elrod, Ill. Wes. Univ., Bloomington, Ill.

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For Sale.—Holmes' System of Surgery by Packard. 3 vols., calf, 1881, new, for $15.00. (regular price, $21.00). Hares's System of Practical Therapeutics. 3 vols., calf, 1891, new, for $12.90. (regular price, $18.00.) Dr. Ashmead, 45 Macdougal St., New York.

For Sale.—"Die Modernen Theorien der Chemie," by Lothar Meyer and Bernthsen's "Organic Chemistry," both well bound and unused. Address L. M. Otis, 214 S. 37th St., Philadelphia.

Wants.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

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SCIENCE

NEW YORK, OCTOBER 20, 1893.

INDIAN RELICS.

BY C. M. PLEYTE, KEEPER OF THE ETHNOLOGICAL MUSEUM OF NATURA ARTIS MAGISTRA, AMSTERDAM.

SOME time ago Mr. R. J. Neervoort v. d. Poll, well known among entomologists, invited me to see his ethnological collection, the specimens of which amounted at that time to about a hundred and fifty. Though his collection has been brought together by buying and exchanging a new object here and there, it contains, as nearly every private collection does, weapons, utensils, dresses, tools, etc., from all parts of the world. The greater part of them, however, were brought back from Indonesia (the Malay Archipelago), especially from the island belonging to the Dutch crown, as well as from our colonies in the West Indies, especially Surinam. This country was visited by Mr. v. d. Poll himself, some years ago, with the purpose of completing his collection of insects. On his return from his journey, after the determination of the new additions had been finished, Mr. v. d. Poll went to Paris in order to make arrangements for the publication of these new specimens. It was on this occasion that he had the good luck to fall in with some very good old American Indian objects, the description of which I think may interest the readers of *Science.*

The reason why I think it worth while to publish them in this paper is that they are really relics, gathered at a time when the Indians had not yet experienced the influence of civilization so much as now-a-days, and, moreover, as the person who collected them was no less than the Prince Maximilian of Wied. Mr. v. d. Poll bought them from a friend of the painter Bodmer, one of the Prince's companions on his travels. Bodmer was rather badly off in his last days. He had scarcely enough to live upon. Therefore from time to time he sold some of the objects which were left to him to his friends, very glad to receive some money in exchange, and at last he gladly accepted the offer made by the lithograph N. N. for the rest of his curiosities and original drawings made when in America. The latter gentleman sold them to Mr. v. d. Poll, who entrusted them afterwards to the Ethnological Museum of the Royal Zoölogical Society Natura Artis Magistra, at Amsterdam, so that the remnants of this expedition, till of late lying forgotten in private profession, can now be studied by everybody who will take the trouble to visit the museum above mentioned.

The objects are nine in number.

I. *Pipe* with nicely carved bowl of green soapstone, somewhat in the shape of a very small tomahawk. The bowl is fastened to a reed stem, provided with a small, cylindrical, bone mouthpiece. *Blackfoot Indians*

II. *Tomahawk* made of a cylindrlcal piece of green-and-white spotted serpentine fastened in a wooden handle. The latter is a wooden strip bent round the stone. The two remaining ends are laid against each other and firmly bound together with a strip of buffalo hide of a reddish color, ending in a loop. *Mandan Indians*

III. *Pair of moccasons* of yellowish leather. The instep is richly decorated with blue and red porcupine quills. *Mandan Indians*

IV. *Pair of moccasons* of black leather, on the instep and at the sides docorated with dyed porcupine quills. *Blackfoot Indians*

V. *Medicine bag* made out of a dried dogskin from which the hair has been scraped off. The bag is split at the chest, and is drawn together by means of a hard leather ring round the neck. The head, legs and tail dangle loosely at the bottom part of the bag. The tail is ornamented with red flannel. *Mandan Indians*

VI. *Medicine bag* made out of a dried skin, the sides are ornamented with dyed porcupine quills and bundles of hair. *Mandan Indians*

VII. *Sheath* for a knife, made of leather, richly decorated with dyed porcupine quills and leather fringe. *Mandan Indians*

VIII. *Leather jacket* made of soft yellow leather, with short sleeves, decorated all over with blue and black bundles of hair fitted into little tin cones. On the front the totem is embroidered with silk, a black circle with two red ornaments in it. *Blackfoot Indians*

IX. *Buffalo robe,* the outside still showing the hair, the inside prepared and adorned with porcupine quills forming a striped, square pattern with bird-shaped ornaments at the sides. *Blackfoot Indians*

The costume formed by the Nos. I., IV., VIII. and IX. was taken from a Blackfoot chief, whose portrait, unhappily enough, is not found in any of the editions of the Prince's famous work on North America.

SCIENCE TEACHING IN SECONDARY SCHOOLS.

BY GEO. G. GROFF, LEWISBURGH, PA.

ATTENTION should be called to the very loose and imperfect manner in which many of the more popular text-books for use in elementary and secondary schools have been prepared. A few years ago copies of an elementary work on natural history were sent the writer for examination. After looking it over, the publishers were informed by the writer that he could not endorse the b ook. In reply, he received a printed list of names of several hundred educators who strongly commended the work. This list was carefully studied, but not a name known to science could be found in it. The book referred to was written in such a slipshod manner as to contain misleading errors of statement on every few pages.

There is a very popular chemistry in use in secondary and high schools, of which it is affirmed that in the first editions the author said, "An old woolen shirt can be made to yield its weight of sugar!" Be that as it may, the errors still in the book after use in the schools for nearly a generation are numerous enough. The following may serve to illustrate: "We say, 'We are so warm that we pant.' Really it is the reverse. The panting is the cause of our warmth." Speaking of the borax beds of Nevada, the statement is made "There are hundreds of acres covered to a depth of nearly two feet with crude semi-crystalline borax." Of chloral hydrate it is remarked, "Taken in proper quantities it is entirely safe, and is exceedingly pleasant in its influence." "Albumen may thus be carried by the blood through the system, but when once deposited, it cannot be dissolved and washed away again." Probably no school books are so full of errors as those hastily prepared to meet the demands of the new temperance laws now in force in most of the states, requiring the effects of alcohol and tobacco on the body to be taught in the schools.

One of the best of these books several times makes the positive assertion that tobacco produces cancer in its users.

Another volume asserts that consumption may be caused by putting on spring clothing too early in the season! One also reads that cider-drinkers are peculiarly crabbed and cross, that tobacco makes old men illnatured, that sour milk is unwholesome, cheese is indigestible, *pork is a meat not fit to eat,* and bile has the properties of baking soda? Here is a fish story told in the words of a highly commended book: "The Esquimaux who live in Greenland, drink one or two quarts of oil, and eat several pounds of candles every day!" But see how a story will "grow" even in a scientific text-book. In the next number of the "series" written by the same author, and from the same reliable notes, doubtless, we read, "An Esquimaux consumes about twenty pounds of blubber fat daily, besides drinking several quarts of train oil." What it will be in the next volume, who can tell?

As to the style and accuracy of these "scientific" treatices, the following may be taken as samples: "The eyeball is a bag (!) almost round, thick and dull everywhere but in front, where it has a transparent covering called the cornea, meaning a horn. This is fitted into the eye just as a watch-crystal is fitted into a watch."! How lucid and true, now proceed, "The back chamber" (of the eye) "also holds a jelly-like fluid, called the 'glassy humor,' which allows the iris-curtain to float and move freely." Who don't understand that much at least?

Another matter in connection with these physiologies should receive attention. Many of them contain a statement, printed in a prominent manner in the first portion of the book, that they contain "*a fyll and fair treatmant of the nature and effects of alcoholic drinks and other narcotics in connection with relative Physiology and Hygiene.*" When the books are examined, however, the "full and fair treatment" dwindles into statements true and imaginary, of the evil effects of alcohol on the body. There is no effort at all made to discuss the different effects of large and small doses, of the effects on a full and on an empty stomach, of individual idiosyncrasies and not a word of the beneficial effects of alcohol and narcotics when properly used. There can be no doubt but this unfair, unscientific and untruthful manner of presenting this subject is having an effect, exactly the reverse to that which is intended. Children will soon find out that they have been deceived, and the result will be worse than if nothing had been said at all on the subject.

The strictures here noted apply to the books used in the public schools, and to a very limited extent to those used in academies and colleges.

BIRDS OF RARE OCCURRENCE IN NORTHERN COLORADO.

BY WM. OSBURN, NASHVILLE, TENN.

COLORADO is prolific in bird life. There the eastern and western forms converge. There mountain, valley, woodland, lake and barren plain, contribute their peculiar species, thus furnishing to the student a field most varied. When observers have completed the record, their labors will probably show a list approaching four hundred species and varieties.

During the years 1888, 1889 and 1890 I had opportunity to study the avi-fauna of a small section of the State. My field of observation was Larimer County, with Loveland, Colorado, as headquarters. Loveland is about seventy-five miles north of Denver, in the midst of a rich farming section, with the foothills some six miles to the west and the open plains a few miles east. During the period named two hundred and forty-one species and varieties were observed. All but a very few of these were actually taken in the field; their skins were preserved, and such data recorded as sex, measurements, color of iris, contents of stomach, etc. From this list I have selected ten birds which to me proved of unusually rare occurrence. Their enumeration may be of interest to other observers. It is not improbable that a few of these have hitherto escaped observation in the locality named and contiguous parts.

Micropalama himantopus. Stilt Sandpiper. Occasionally met with during the spring migration, in May and early June.

Pediocaetes phasianellus campestris. Prairie Sharp-tailed Grouse. This bird was formerly quite abundant.

Accipiter atricapillus. American Goshawk. A male of this species was captured on February 26, 1889, at Arkins, Colorado. A female was taken in the same locality on March 5. The male was much darker than the female, and with finer markings on the under parts, answering to the description of variety *striatulus.* Mr. Wm. G. Smith, a careful observer of birds, reported at the time that he had not seen a specimen of this hawk during five years residence. In his "Key to North American Birds" Dr. Elliott Coues says: "It breeds in mountainous regions as far south at least as Colorado, where I have seen it in summer.

Bubo virginianus arcticus. Arctic Horned Owl. A fine Horned Owl, which I have referred to this variety, was shot in the mountains and brought to me on Nov. 29, 1890. It was nearly white. A dissection revealed a large tape-worm in the back, above the intestines.

Colaptes auratus. Flicker. A typical Flicker was taken during the fall migration, September 24, 1889. While the hybrid form, exhibiting every conceivable gradation between *auratus* and *cafer,* is quite abundant, yet a typical *auratus* is seldom observed.

Scolecophagus carolinus. Rusty Blackbird. One specimen was taken in November, 1889. No other observation recorded.

Zonotrichia coronata. Golden-crowned Sparrow. Concerning the habitat of this species, Dr. Coues makes the following record: "Pacific coast (to Rocky Mountains?) from Alaska to Southern California." A small flock of these birds spent the winter of 1889 in a thicket along the Big Thompson. They were associated with Intermediate Sparrows. One specimen was taken on February 23.

Dendroica graciæ. Grace's Warbler. During the spring migration of 1889 a small flock of this species was seen near the foothills. One specimen, taken April 25, is in the writer's possession.

Cistothorus palustris. Long-billed Marsh Wren. Two specimens were taken in March, 1889. Its occurrence is apparently not common.

Among others collected, the following may be named as more common than the preceding, yet only met with occasionally: Golden-crowned Kinglet, Wilson's Warbler, White-throated Swift, Cedar Waxwing, Slate-colored Junco, House Finch, Arizona Goldfinch, Pallid Horned Lark, Woodhouse's Jay, Hammond's Flycatcher, Alpine Three-toed Woodpecker, Pigmy Owl, Prairie Falcon, Richardson's Merlin and American Golden Plover.

—"Our Own Birds," by Wm. L. Bailey, published by J. B. Lippincott Company, is an excellent little manual for those who wish to become familiar with the common birds of this country. It contains a number of half-tone full-page illustrations, with others in the text.

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

CAN WE SEE THE PICTURE IN THE LANDSCAPE?

BY WALDO DENNIS, CHICAGO, ILL.

OFTEN while enjoying a painting I have wondered where lay the secret of transforming commonplace scenes into interesting and beautiful pictures. I have been entranced by paintings of which the scenes themselves, I am sure, would not have stirred my feelings. Coloring did not account for this magical change, thought I, for in both scene and picture they are the same. To say it was the artist's power to idealize, even if true, left the matter no clearer. Because "idealize" stood not for something known, but for something unknown, and thus, instead of clearing up the mystery, it only appeared to.

Lately while looking at a painting in the Art Building at the World's Fair, some light came to me. The painting was beautiful, and yet the scene was commonplace. At once came the question, "Was that landscape really so beautiful to the artist as he has made his picture? Did the artist really see, in the scene before him, the picture he has painted? In short, was the scene a *picture* to him before he painted it?" Thus meditating, I unconsciously tried to see the landscape as he must have seen it, to look at it through his eyes.

Evident at once was the difference between looking at a landscape and the picture of it. A landscape covers several or many square miles. In looking at it, our eyes wander over it, from place to place. To look to the left, a direction to the right has to be turned away from. While regarding the farmyards in the foreground, we see less distinctly the wooded hill of the background. As one part passes into view, another part passes out of it. In fact, every portion of the scene before us must be seen in its own particular direction, and with its own particular focal adjustment. The conditions of distinct vision thus imposed enable us to see one thing well at the cost of seeing all else faintly.

How different is all this in looking at the picture. The many square miles have been reduced to a square yard. The multitude of objects, which to be seen well require the eyes to wander about, and to constantly readjust themselves, have all been brought to the same plane, and can all be seen at one glance. Moreover, while looking at the square yard of picture your attention is not distracted, as in the scene, by a flock of blackbirds suddenly flirting up from among the cattle in the pasture, circling about in a whimsical way, and then as suddenly dropping down again in the same place. The man at the plow does not finally reach the end of his furrow, turn his horses and come back; nor does the wagon on the road move along as it seems to be doing, and compel your gaze to follow it till it passes behind the hill out of sight. All things are caught in an eternal pose, which offers no interruption to your gaze. You see it all at a glance, and you see it always the same, that is, without distracting changes.

In this transfer of a scene to canvas, plainly the beauty of the landscape is concentrated. The variety of color and form scattered through miles of extent is crowded into a glittering square yard. It is like the enchantment wrought for us as children by a fragment of looking glass. The glass reduced the landscape before us to a picture, and thus enabled us to comprehend it; beauty flashed out upon us, where before we had not so much as thought of there being any beauty, and I am persuaded that, in general, only as we have power in some way to picture the scene before us, do we gather its beauty. We may be greatly attached to a familiar scene; this attachment may help us to its beauty; but how much of this we see, depends on our power to picture the scene.

And here our question comes back to us: Did the artist see his picture in the scene from which it was taken before he painted it? But for an experience of my boyhood I should conclude that to see a landscape as a picture were out of the question. When a boy I was somewhat addicted to dreaming with my eyes open. As my reverie engaged consciousness, I was little aware of the scene before me. But as the reverie concluded itself the *scene* began to obtrude itself. In this condition of waking from what was passing within to a consciousness of what was present without, there was an interval, during which I saw the scene before me as a whole, as a picture. Consciousness not yet distracted into making a focal change was passively attentive to a larger and larger field of the retina. The eyes, in their staring fixedness, seemed literally optical instruments through which an inner self was peeping, and stealthily peeping, lest a disturbance should take away the opportunity by destroying the conditions. This experience was like waking from a delightful dream; it always left me feeling like one having visited another world whose beauty was unspeakable. Recalling this experience led me to conclude that the power to see natural scenes as pictures may be acquired. Subsequent trial has proved it to be true.

Of course we cannot escape our visual limitations. As the field of view becomes larger and larger, distinctness of the whole of it suffers. But experience shows this to be no serious obstacle. Our general familiarity with nature enables us to form a clear mental image from an indistinct visual impression. The man we see at his work or the cattle in the pasture need not be seen very distinctly for us to know what they are and what they are doing. In their contribution to the picture this is sufficient.

The enjoyment of standing at will in the midst of a gallery of pictures in nature's own coloring can be understood only by one who can see them. Whoever enjoys nature enough to look for her pictures will find them. And in them, once found, his eyes will be opened to beauty that he knew not of before. Thus to see and feel the unity in the scene before us, seems like seeing with other eyes than the physical, like neglecting external form and getting at the spirit of beauty.

CORAL FORMATIONS.

BY G. H. PERKINS, UNIVERSITY OF VERMONT, BURLINGTON, VT.

WHEN the old navigators, after long and weary voyaging, at last came upon the coral islands of the southern Pacific and gazed with delight upon the circles of green foliage lifted above the frothing breakers, verily they must have thought that they had found the Enchanted Isles.

Probably no portion of the earth's surface is more like fairy land or more wonderfully beautiful than a typical coral island. But the beauty of these islands, although so exquisite, is not their chief attraction, for as one learns how numerous they are, how unique their structure, how peculiarly they are distributed through the oceans, how unlike other reefs and islands is their form, elevation above sea level, and indeed everything that pertains to them, he becomes eager to know why they are as they are and by what processes they have come into being.

It soon becomes evident even to a very casual observer that the geological and chemical principles, which are sufficient to explain the existence of other reefs and islands, are not satisfactory when applied to these, and that some different conditions must be sought to account for the different results which have been attained in these singular structures.

What these conditions are or have been in the past it is not easy to determine, and, although from the time of the first navigator coral formations must have excited curiosity, no theory to account for them was made known until in 1837 Mr. Darwin, after his voyage in the Beagle, published his well-known theory.

From the first this theory was received with general approval, nor is this strange, for it is at once so simple and so apparently sufficient that nothing more seems to be needed. This theory was also greatly strengthened by the endorsement of Professor Dana after his return from the Wilkes Expedition in 1842.

For many years Mr. Darwin's theory was scarcely questioned, and certainly there is nothing improbable in any of the conditions which it requires. The only question is, Do the observed facts warrant its acceptance? As will be remembered, Mr. Darwin supposed that the whole vast area in which coral islands are found has been slowly sinking for a very long time, that islands of the usual sort, which formerly existed, have wholly disappeared through subsidence, and that about these islands there grew masses of coral which in time formed fringing reefs, that as the island sank the coral grew upward more rapidly on the outer or seaward side because there food was more abundant, and as the island sank the reef would presently be separated from the island by a strip of water; that is, the fringing reef would become a barrier reef. Finally, the island having disappeared, the reef, would become an island of more or less annular form enclosing a lagoon that is an atoll.

So long ago as 1851, Professor Agassiz, after studying the Florida reefs, declared that he found no evidence of subsidence, and that the structure of the southern part of Florida must be explained in some other way.

So also Semper, in the Pelew and Philippine islands, Dr. Guppy in the Solomons, and Dr. Bain in the Bermudas, had been studying coral formations, and all these observers found the old theory inadequate to account for the structural peculiarities noticed.

Later, and more important than these, are the observations of the naturalists of the Challenger at Tahiti, which have led many scientists to reject the commonly received theory.

However great the dissatisfaction with Mr. Darwin's theory may have been, it was not given utterance until in 1880 Mr. Murray, one of the Challenger naturalists, published a theory quite unlike that which had been current. Although first stated by Mr. Murray, this theory is to be regarded as an outgrowth from the objections to the older one.

Mr. Darwin himself noticed that in some cases corals grew upon submerged platforms or banks and also that the growth was most rapid on the seaward side of a reef where food was most abundant, and all subsequent investigators have noticed the same fact.

Mr. Murray assumes a sufficient number of such platforms to afford foundations for coral growth, and that the peculiar form of reef or island would be determined by well-known conditions.

Of course the upward growth of the coral would be in a solid mass if growth went on equally, and this is sometimes the case, but usually because of the rapid increase of the outer zone of coral and because of the solvent action of the sea water upon the dead or weakly growing coral in the interior zone the forming island becomes annular, that is, an atoll.

Deep-sea soundings have proved that such submerged banks and islands as are demanded by this theory do exist and are more numerous than has been supposed, and also that by the accumulation of shells and all sorts of debris such foundations, if at first too deep, may be raised nearer the surface and into the coral-growing region.

On the other hand, mountain peaks, rising above the surface, may be worn down below it by erosion.

As atolls may begin as fringing reefs and may even at first be platforms of coral rock, so barrier reefs may begin as fringing reefs, and as they grow outward the solid coral be dissolved and worn away between the reef and the land, thus changing one into the other.

There are then these two theories at present before us. Which is to finally prevail? The naturalists of the Challenger expedition are fully committed to the new view and so are many leading English scientists.

If one seeking information should chance upon an article by the Duke of Argyle in the *Nineteenth Century* of September, 1887, or Professor Geikie's Presidential address before the Royal Physical Society of Edinburgh, he would probably conclude that the question had been finally settled in favor of Mr. Murray's views.

If, however, he should turn to the November number of the same periodical he would discover that no such result had been reached and that it is not probable that it soon will be.

Certainly when such an authority as Professor Huxley can write as he does in the latter article, "I happen to have spent the best part of three years among coral reefs, and when Mr. Murray's work appeared I said to myself that until I had two or three months to give to the subject * * * * * I must be content to remain in a condition of suspended judgment," it becomes us to be modest in expressing an opinion.

Should one still seek for information upon this subject he may find in the *American Journal of Science and Arts*, vol. XXX, 1885, sundry articles by Professor Dana in which there is very strong advocacy of Mr. Darwin's theory and opposition to that of Mr. Murray. While it would be idle at present to attempt to decide as to the value of either theory we may perhaps do well to consider some of the facts before us.

That there has been subsidence in great areas of the sea bottom cannot be doubted nor can it be doubted that there are great areas where there has been elevation, and in still other areas there does not appear to have been either rising or sinking.

Evidence is continually increasing that in different coral-growing areas different processes have gone on and that since all coral islands have not been made in the same way no single, all-comprehensive theory is possible.

Dr. Guppy found at the Solomon Islands that, adjacent to the shore, corals grew vigorously, while outside of this zone there was a space where debris from the shore so fouled the water that no corals grew, while still farther out they grew finely. It is easy to see that the first zone would make a fringing reef, the zone affected by debris would be open water, and the outer zone a barrier reef, and thus these varieties of coral formation be produced without the conditions of either theory. Nor is it at all improbable that other methods of coral island making may be discovered as further investigations reveal new facts, and, while it may be regarded as most probable that Mr. Murray's theory will be held sufficient to explain the larger part of the coral formations of the globe, it is also probabable that Mr. Darwin's views will never be wholly set aside, but will always be needed to account for extensive groups of reefs and islands, while here and there all over the region of coral island making there will be found phenomena which require other explanation because of special peculiarities.

THE PROTECTION OF OUR WILD PLANTS AND ANIMALS.

BY JOHN GIFFORD, SWARTHMORE COLLEGE, PA.

A few years ago an association for the protection of plants was founded in Switzerland at Geneva. Tourists, and even botanists, were guilty of such vandalism that many feared the extermination of certain rare plants. By the dissemination of seeds and other means, however, many species have been protected by this society in Switzerland and elsewhere.

Although we have forestry associations in this country we have as yet done nothing toward the protection of rare plants.

In south Jersey, for instance, there are many unusual and beautiful species, but owing to the action of winds, fires and voracious botanists they are becoming gradually scarcer.

Along the beaches of the seashore the forests are destroyed for the building of resorts, in other places they are buried by moving sand dunes. The *Schizœa pusilla* is a little fern, which is not found elsewhere in the United States. It grows in three or four isolated patches in the low pine barrens of south Jersey. One patch has already been almost wholly destroyed by forest fires, and from the others hundreds of specimens are carried away by greedy botanists every September. The extinction of this species is only a question of a very few years.

This applies to almost every locality in the United States. There are few places which cannot boast of a few rare species.

The writer knows of one instance where a class of young botanists exterminated a patch *Aplectrum hiemale*, in a region where it was very rare, by eating the corms.

In spite of game protective societies, owing to the thoughtlessness of sportsmen, many of our wild animals have disappeared. A few deer still linger in the pines of south Jersey, but every season their number is remarkably lessened. Had they a place of refuge where they could always remain unmolested, their extinction could be prevented.

It is hoped that the Government may set aside in every state a tract of guarded land. A few acres showing the nature of the country in the wild state will be appreciated more in years to come than at the present time. There the trees may remain untouched, there remarkable and unusual plants may grow in safety, and there the wild animals may find a refuge. The advantages of such a scheme are too numerous to mention. The retaining of a typical portion of each kind of territory in every state, together with its plants and animals, guarded every day of the year, would not only delight the naturalists and lovers of nature, but would insure at least a small portion of forest country here and there, which tends to lessen in many ways the destructive forces of nature.

Dr. Charles Dolley and others of the American Association for the Advancement of Education have arranged to collect and preserve on their property at Avalon all the plants peculiar to the beaches of the Jersey coast. This is one of the objects of the association, and it hopes to control some land in the low pine barren region where no man will be allowed to botanize or hunt.

SILK SPINNING FLY LARVÆ.

BY H. GARMAN, LEXINGTON, KY.

In a brief paper printed in *Science* recently a silk spinning cave larva was described by me and referred to the order Diptera. Its general appearance and its habit of making a thread are features in which it approaches the larvæ of Lepidoptera, a resemblance which has been commented on by others in conversation with me since. Yet the larva in question is unmistakably Dipterous, and it was part of my object in publishing the note to call attention in an indirect way to the fact long, but not very generally, known,* that larvæ of certain flies approximate the Lepidoptera, in spinning silken threads. In saying that they produce silk, I wish, however, to be understood as in no way implying that the threads have the exact chemical and physical properties of the silken fibres made by the silkworm. They are silk from the biological, not from the commercial point of view. They are produced by special glands differing little, if at all, from the silk glands of other insects, are employed by these larvæ for a purpose, and are not consequently to be compared with the trail of slime left by a slug or worm.

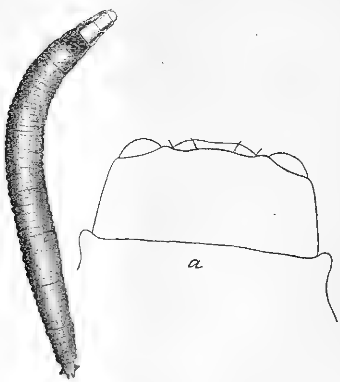

Fig. 1.

My attention was first attracted to such larvæ while making examinations of Kentucky caves. I have, however, been long familiar with other larvæ belonging to the same order, which habitually spin threads having a very important relation to their welfare. In small streams in McLean County, Illinois, occurs a larval Simulium which produces such threads. Another species is extremely abundant in rills in eastern Kentucky, where the rocks

*See Westwood's Modern Classification of Insects on Larval Mycetophilidæ.

over which water flows with considerable speed are literally blackened with it. Since the note referred to was published I have observed that these latter will when disturbed let themselves loose in the current and then shoot down stream emitting their threads at the same time so that they can check their descent and secure a fresh hold on the rocks, perhaps to return along the thread to their first position. By closing the blades of my forceps over the rocks I have repeatedly drawn out a string of these larvæ, each one suspended by the thread it had let out as it floated down stream.

In addition to this thread-spinning habit the cave larvæ have peculiarities of structure which render them worthy of careful study. I have already described two of them, and have collected several others in Kentucky. All are more or less vermiform, being long, slender, cylindrical, generally translucent, so that the internal organs show more or less distinctly through the body wall. The resemblance to a small Lumbricoid worm is heightened by the fact that their bodies are coated with a slime, the derivation of which is uncertain, but which is probably not

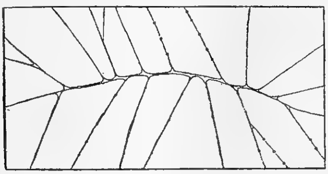

Fig. 2.

derived from the glands engaged in secreting the thread. There are common features also in the structure of the head and mouth-parts, and in the presence of a singular convex area above the base of the mandible resembling a very large ocellus. In several of those examined this is of enormous size, and gives the head a most bizarre appearance.

That they are Dipterous larvæ is sufficiently evident from their resemblance in general structure to larval Sciara. The recent discovery of the pupa of one of the species, with wing pads and halteres clearly apparent, confirms the opinion I had reached in this regard. While engaged in attempting to rear the adult of this species I received additional proof in the shape of a letter, quoted from below, from that most excellent observer and collector, Mr. H. G. Hubbard, together with three stages of a closely related species which he discovered some years ago in a cave in Jamaica. The larva of this species is closely allied to one found by me during the past August living in hammock-like webs slung across depressions on the under side of stones and lumps of earth. The latter species was taken in a small cave near Lexington, and has afforded me an opportunity to observe more closely the product of the spinning glands of these interesting insects, and to watch the larva while making its web. This larva shows the same attachment for its web as does the species previously described. In one instance an example was compelled by particularly rough treatment to creep to the earth at one side of its web, where it remained drawn up in an uncomfortable position, but turned promptly when left unmolested for a moment and made its way back on the web again. Three living examples were at one time thrown into a watch glass of water preparatory to killing them in an extended condition, when every one fastened itself to the bottom by pouring out the glutinous material from its mouth and then began to wriggle like an uncomfortable earthworm, always with the whole length of the body free from the glass. In this case the slime coating of the body showed no tendency to glue the body down, whereas the matter from the glands opening at the mouth retained all its adhesive proporties—an evidence that the slime is of different origin, and is produced for a different purpose.

Since Sept. 3 a larva of this sort has been kept alive in a bottle. In the bottom of this is about half an inch of earth. The larva spends most of the time in the empty upper part and makes its way about in this space, building a web as it goes, with surprising rapidity. It is often fully two inches from the earth and very rarely touches the side of the bottle with its body. When engaged in web-building, it sways the forward part of the body from side to side until it strikes some object, when the thread is attached by a touch, and as the head draws away is seen to be connected with that underlying the whole length of the body. When first drawn out these threads appear under a hand lens as smooth and dry as any spider's web. The central strand upon which the larva usually lies, however, has a good deal of slime along it, forming triangular masses at the points of divergence of lateral threads. When they have been used for some time the lateral threads of a web may also show slime upon them in the form of minute scattered spherical droplets (See figure). As far as I can determine all this slime comes from the surface of the body. Occasionally a portion of the body has been seen to come in contact with the bottle, where a slimy trail nearly as wide as the body was left on the glass. If this slime had the properties of the glutinous material of which the thread is made the larva would have difficulty in getting about. On the contrary it is rather fluid, and the droplets left along the strand can be seen to be drawn up by the force of capillarity as the tip of the body passes them.

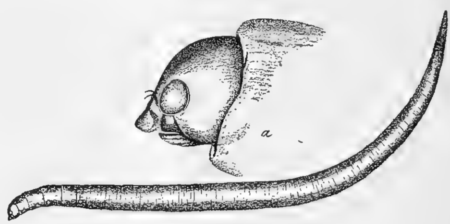

Fig. 3.

These larvæ live concealed in damp situations and it may be, as suggested by Mr. Hubbard, that the threads do not become perfectly dry. They are so fine and delicate that it would be difficult to determine this matter. The thread-making larva previously discribed in *Science* is at all times completely exposed on the rocks. I have had no recent opportunity to examine its threads, but the impression I have of those seen last spring is that they were dry. But the question whether or not the threads of these larvæ are completely dry has nothing to do with that concerning their essential nature. If silk must be chemically dry, then of course the thread of larval Simulium is not silk. It is not the product of a gland having to do with digestion. It is not a trail of slime left from the surface of the body. It is a special product, used by these larvæ exactly as the silkworm uses the product of its sericteria (even to enclosing the pupa in some cases in a very slight approach to cocoon).

Mr. Hubbard's larvæ are very much like the species upon which my observations have been made, and their threads of slime very probably have a supporting axis of other material. The following quotations are from his letter accompanying the specimens so kindly sent me. I hope to publish descriptions of all the cave species at some future time. Adult Mycetophilid flies have been collected by me on several occasions in parts of caves in which my larvæ were found, but it will be necessary to "breed" the pupæ and adults from the larvæ before the stages can be associated with certainty.

"I have never seen your larva, but I have from a cave in Jamaica, W. I., a Dipterous larva of similar form and habits, except that it lies suspended free from the rock on a thread of ropy slime-like material. I send you specimens of this larva and also its pupa in alcohol, likewise the imago which I bred from the pupa. You will see that it is a Mycetophilid fly. No doubt you have noticed similar flies in fungi and particularly on coatings of fungi under damp logs in dark woods. The larvæ of these fungus-inhabiting flies are similarly elongate creatures and form thread-like tracks of slime across the surface of the fungus. I have frequently observed that they can be made to glide back and forth along this track precisely in the manner of your cave larva, and that they can not be induced to quit their hold upon the thread. The interesting point to which I would like to call your attention is this. The silken thread of your Mammoth Cave larva and the slime thread of my Jamaican larva as well as the slime track of the fungus Mycetophilids may all be similar products of the salivary organs and more or less allied to true silk. The Jamaican cave fly makes a thread of six or eight inches in length fastened at both ends to the rock on the underside of a ledge or stalactite, but otherwise hanging free, and on this both larva and pupa are found suspended as in a hammock. In the damp air of the caves the thread never dries and hardens like ordinary silk, but remains viscous and slime-like as in

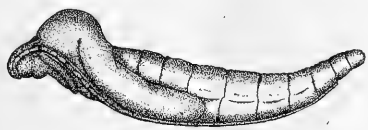

Fig. 4.

the case of other Mycetophilids. Nevertheless it possesses greater strength than an ordinary filament of mucus and it occurs to me that it is nothing more or less than a form of silk which does not lose its moisture and become hard. I have read somewhere quite recently of a process for the manufacture of artificial silk from a collodion produced by the action of nitric acid upon palm fibre. This silk remains moist until passed through anhidrous ether, which removes the moisture and hardens it. I would like much to know whether the silk thread of your cave larva is not also somewhat viscous, and it would be interesting also to note the action of ether upon it.

"In the *American Entomologist*, Vol. III., p. 30, 1880, I published a brief account of cave life in Jamaica. The article refers to the fly as follows; 'A Mycetophilid fly is found upon the stalactites, where its vermiform larva may also be seen suspended by ropes of slime.' Referring to my original field notes I find the following: 'Drunilly, Parish of Trelauny, Jamaica, W. I., April 18th, 1877,—among notes of examination of a large cave, much frequented by bats and containing many tons of bat guano—under ledges of stalagmite, long Dipterous larvæ slung in glutinous threads. Pupæ also collected slung in same manner. Probable imagoes also found. (I subsequently observed a pupa disclosing the fly and took specimens of all the stages.)' "

Explanation of the Figures.

Fig. 1. A dorsal view of a Mycetophilid larva found under a log. a, an outline of the head as seen from above.
Fig. 2. A web of one of the cave species.
Fig. 3. A web-making cave larva. a, an enlarged side view of the head.
Fig. 4. The pupa of the larva represented in Fig. 3.

SCARS ON APPLE TREE TRUNKS.

BY FRANK BOLLES, CAMBRIDGE, MASS.

Old apple trees in New England are almost invariably thickly dotted with round scars in their bark. Chains of small holes seem at some more or less distant date to have been bored in the trunks and larger limbs, but to have healed without injury to the tree. I have seen trees which bore thousands of these marks, arranged with some appearance of regularity in rings encircling the trunk and extending tier upon tier from a few inches above the ground to a point much higher than a man's head. In meetings of ornithologists I have heard many of those best informed about birds' habits say that they were unable to name the maker of these marks. Farmers generally charge the Downy Woodpecker with doing the work, and they often call him a Sapsucker in consequence. Many people suppose that the holes were bored a long time ago, and that they are not now made, hence the impossibility of observing the bird while making them.

For several years I have kept close watch upon my old orchard at Chocorua, N. H., hoping that I might catch the little Sap-sippers at work. While my experience with the Yellow-breasted Woodpeckers inclined me to suspect them of being the birds concerned, I did not feel at all sure that the Downy, who is so fond of stealing a drink of sap from the drills of the Yellow-breasted, might not have learned to do some boring on his own account. This autumn I noticed half a dozen freshly made holes in a very old apple tree. That proved clearly the continued existence of the unknown worker. During September both Downy Woodpeckers and the Sapsuckers were abundant and very busy in my apple trees. The Downy was fearless and honest in his manner. He was after insects and he showed no shame and little timidity. The Yellow-breasted Woodpeckers, on the other hand, were very shy, and flew from a tree almost as soon as I came within sight of it. This led me to watch them persistently, and at last, not long before I was called back to Cambridge, I had the satisfaction of seeing one at work, drilling and drinking. After making perfectly sure that he was cutting new holes and drinking, I examined the holes closely and satisfied myself that they were identical with the kind so long in dispute. To wary *Sphyropicus varius*, therefore, in his autumn migration, is to be assigned the fretting of our old apple trunks. That he does all of this work, I believe, but cannot, of course, affirm without more evidence.

A MISTAKE IN TEACHING BOTANY.

BY B. FINK, FAYETTE, IA.

Under the above caption I wish to enter a protest against the method of teaching botany still in vogue in certain colleges and high schools. If the error named below prevails in any large University, it needs correction there as well. It exists in our village schools, and will till the higher schools make a change for the better, and send out teachers correctly trained in the subject.

The mistake is the old plan of a spring term in botany confined to a study of phanerogams, followed by the analysis of from fifty to one hundred plants. This way of studying botany came into use when the microscope was scarcely known among the masses, and when the economic interest of the lower orders of vegetable life was not well understood.

It is a source of pleasure to be able to name the common flowering plants, and the practice in analysis is good; but the teacher might better tell the names of the plants and save the time for more important work if the pupil can spend only one term upon the study, and as for the analysis, experience shows that a large part of the work not done under the supervision of the teacher is accomplished by ascertaining the common name and then going to the index.

Some teachers who have followed the old line in elementary botanical instruction will hardly be convinced that other matter should precede. They think that phanerogams are the most noticeable plants and should therefore be studied a whole term even if the lower forms are never known. The fact that they are so noticeable that any one who is really interested and who has had some work in observing and describing phanerogams will learn their names by analyzing, or in some other way, is my reason why the limited time often given to the study should not be devoted exclusively to this class of plants.

Some who have been going on in the old rut will contend that phanerogams were the first plants investigated, and that the order of presentation should follow that of investigation. Let us see. In geology, investigation began at the surface, with the latest formation; but in the study we begin with the deepest stratified rocks, the first formation. In zoölogy the highest forms of life were first studied and first present themselves to the observer, but here again the order of presentation has been changed so that it is the reverse of that of investigation.

However, I think it is not of so much importance where we begin as that we give first a general knowledge of the orders of plants. If those who have been confining their work to flowering plants will give half of it to cryptogams I will not find much fault with them for beginning with the highest order. Yet I think I have proven that the other way is as good without even introducing the principle of going from the simple to the more complex.

Every one who studies botany at all should learn something about bacteria, which play so important a part in our welfare. The same may be said of the economic smuts, mildews and rusts, and many other forms that I need not mention. Vegetable physiology should also form an important part of the work of the first term if it is to be the only one, and the necessary time can be gained by omitting the analysis of so many phanerogams and substituting the examination and description of a plant from each of the more common orders, using the microscope when necessary.

Instead of the old plan I would have all schools, during the first term, take up the orders, proceeding from the lowest to the highest, and close the work with the leading facts of vegetable physiology. I would divide the time equally between cryptogams, phanerogams and physiology. This both gives the best foundation on which to build, and is the most essential knowledge for the student who can not give more time to the subject.

FUNGI VERSUS INSECTS.

BY GERALD MCCARTHYR, RALEIGH, N. C.

During the last twenty years the number of species of noxious fungi and insects infesting American fields, orchards, woods and storehouses has increased at a most alarming rate, with a commensurate increase in the damage they inflict. The time was when the substantially complete destruction of any crop by these pests was so rare as to be regarded as a special visitation of Providence. This increase is undoubtedly due to the perfection of modern commerce, which has made cosmopolitans of species formerly restricted in habitat, and to the opportunity for rapid multiplication that our large solidly planted fields afford. Notwithstanding the vast amount of study which has during the same decades been devoted to these pests and the many differentforms of apparatus, formulas and methods which have been devised for combatting them, the damage still done is very serious. In fact intelligent and practical men say that the claims put forth by economic scientists have not been fulfilled. While the copper salts against fungi and the arsenites and kerosene against insects have in individual cases given good results, they have not apparently reduced the numbers of these pests. The use of these substances, too, is not without drawbacks. The acrid copper mixtures often damage the trees or plants nearly as much as the fungi would have done, and fruit plastered with these chemicals does not sell well. To be sure, it is not necessary to plaster fruit with the fungicide, nevertheless it is done, and where spraying is in general use the fruit as marketed is seldom free from its presence. An example of this, which has made a vivid impression upon my mind and stomach, is a lot of Catawba grapes grown near Seneca Lake, N. Y., and sold in Raleigh, N. C. These grapes were considerably spotted with the Bordeaux mixture. As an experiment I purchased and ate a bunch of these grapes, rejecting the skins,—an experiment I am not likely to repeat very soon! The flavor was quite spoiled by the presence of the chemicals, and the effect upon the digestive organs was anything but pleasant. The use of chemical fungicides, like the use of patent medicines for human ailments, has a tendency to cause the user to neglect hygienic precautions, since these latter require more foresight and labor than the former. In spite of all that fungicides have done, the annual losses caused by noxious fungi are still, for the United States alone, $300,000,000.

The losses occasioned by noxious insects are scarcely smaller. In a single year Illinois has lost $75,000,000 by the clinch bug and Texas has lost $20,000,000 by the cotton caterpillar.

The capital fault in all topical treatment of these pests is that it is effective only so far as the treatment goes, and for the time being. Let us suppose A., B. and C. to be neighboring fruit growers. A takes every practicable hygienic precaution by burning all infectious matter, and by cultivation and fertilization stimulates his crops to outgrow their enemies. B has unlimites faith in his "pizen," and applies it with a liberal hand. C is a "one-horse" farmer and has no faith in anything. He lets the bugs alone. The net result is that C grows more fungi and insects than fruit, and enough to devastate his neighbors' crops after his own are ruined. B has bespattered his trees right and left and caused most of the leaves to drop or shrivel up, followed by the fall of the immature fruit. A in spite of all his trouble and expense sees his crop ruined, or if he overcomes his prejudice against the use of chemicals, saves only a part of the crop and that more or less deteriorated. Surely there is something lacking in this method of procedure!

What is wanted is an automatic antipest destroying agent which will do its work quickly, thoroughly and without the aid of such men as farmer B and in spite of such men as farmer C. Such an agent many think we have found in pathogenic, contagious disease producing fungi or bacteria. It is well known to the farmers of the west that in some seasons the swarming multitudes of clinch bugs after devouring the crops disappear suddenly and as if by providential interposition. This disappearance usually follows a period of wet weather and does not as a rule occur until the pests have done irreparable damage and increased until their loathsome presence is everywhere found. The real cause of this sudden disappearance has been found to be a contagious bacterial disease whose rapid dissemination is favored by wet weather and by the crowding of the insects into restricted areas as the food supply decreases. In this case the disease is left wholly to spontaneous development, but it is reasonable to suppose that were the disease producing bacteria artificially cultivated and multiplied, which is readily done in properly equipped laboratories, and held as a magazine to supply the germs as soon as the first insects are seen, the pests might be swept away, at a merely nominal cost, at the beginning instead of at the end of their destructive career. This is not all theory! In the United States excellent results against the clinch bug have been obtained in Kansas, Illinois and other states. In Europe very satisfactory results have been obtained in combatting the "white grub" (*Melolantha vulgaris*), by means of the fungus, *Botrytis tenella and B. bassiana.* In this country the most satisfactory results have been obtained from *Sporotrichinm densum* and *Empursa,* several sp ecies.

This method of combatting noxious insects is now attracting widespread attention from German and French scientists and promises much for the future.

LETTERS TO THE EDITOR.

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

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

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

Inductive Psychology.

I wish to thank you for your appreciative words and criticisms of my "Inductive Psychology," which was hastily prepared for private use rather than to stand the test of criticism for general circulation; I am pleased that more defects are not at once discovered. I think, however, a little explanation from me is necessary upon one point. In writing every sentence of the book my principal question was, what experience of the pupil will this appeal to? what thoughts and observations will it suggest? and not, how can I most logically state these truths so as to completely cover the subject? The aim is not a complete treatment of the science, but an *introduction* to it that shall give the pupil psychological knowledge, power and vocabulary that will enable him to continue the study in both living subjects and books. To such an extent is this true that inferences as to what portions of psychology I value most cannot be correctly made, for my principle of selection was not scientific value and importance but pedagogical value to the pupil at this stage of the study.

Now, Mr. Editor, however much you may disagree with my use of the word "inductive," if you will lay aside the expectations that the word "inductive" in the title aroused in your mind, you cannot but see that the book is pedagogically essentially different in method from any other text-book on psychology. I feel as if explanation on this point is due to myself; for if the book is not different in method of presentation from other psychologies, I have no excuse for writing it. The following, however, from a teacher of psychology, confirms me in the belief that I have such an excuse. "The book is the best I know of from the *teacher's* standpoint. It illustrates a method of treating the subject which I find in no other book. So far as I know, most text-books have been elaborated without regard to the pedagogics of the subject, but only the logical and scientific arrangement of the facts enumerated; but I feel that this cannot be said of yours."

E. A. Kirkpatrick.

Winona, Minn., Sept. 25, 1893.

The Sounds of R.

As Mr. Melville Bell complains, in your October number, that the sounds of R have been treated unscientifically in my "Introduction to Phonetics," (Sonnenschein, London, and Macmillan, New York, 1891), I beg to observe that the difference between us arises from the difference in the facts observed by each.

In my pronunciation, for instance, and in that of cultivated English people of the present day, his ear would, I am sure, observe no difference between *alms* and *arms*, or between *laud* and *lord.*

In my treatment of the *r* sounds in English, I am supported by the evidence of all competent observers of the best English spoken in the south of England in the present day, and the leading phoneticians are also agreed in regarding this as standard English. I refer to such men as Dr. Sweet, Prof. Johan Storm, of Christiania, and Prof. Victor, of Marburg.

If I were making a study of American English it is probable that my observations would be in accord with those of Mr. Melville Bell.

Laura Soames.

Brighton, England.

The Absence of Air from the Moon.

Seeing in the journal *Nature*, of London, date August 31, 1893, the announcement of a paper entitled "The Moon,s Atmosphere and the Kinetic Theory of Gasses," to be read next week at the meeting of the British Association at Nottingham by the author, Mr. G. H. Bryan; and since this subject was treated by me in *Nature*, Nov. 7, 1878 (15 years ago), I wrote to the author, Mr. G. H. Bryan, in reference to this. He has informed me to-day by post that this subject was dealt with in your journal, *Science*, of Feb. 24 last by Sir Robert Ball, who sent his communication to you as original, although Mr. Bryan considers it "identical in substance" with my letter in *Nature* (above mentioned) entitled "A question Raised by the Observed Absence of an Atmosphere in the Moon" (*loc. cit. sup.*)

As Sir Robert Ball makes no mention in your journal of my letter (in *Nature*). I merely wish to claim just priority here for the theory as mine and not his; since it is discussed as his—Sir Robert Ball's—in subsequent numbers of *Science*, such as that for August 18, 1893, in a paper by Prof. Liveing, of Cambridge, England, who suggests a further application of the theory in an article entitled "The Aemosphere of Stellar Space." To make a reclaim is somewhat of a task, and it would be fitting if an author's work were voluntarily recognized without his incentive; but I cannot do otherwise under the circumstances than mention the matter to you in this letter. Mr. Bryan informs me that his paper deals with "the bearing of statistical calculations on the theory," and he makes "no claim to originality except in the numerical results arrived at."

There may doubtless have been some advantage in Sir Robert Ball treating of the theory in question in your journal: but I am surprised at his not mentioning my name in connection with the theory.

S. Tolver Preston.

Hamburgh, Germany, Sept. 9.

Fossils of the Bridgeport Quarries.

One interested in geology, while looking over the fine exhibit of Ward's Natural Science Establishment in the Anthropological building at the World's Fair, and also the geological exhibit in the Government building will notice that the finest crinoids and other fossils of the upper Silurian, Niagara Terrane, are labeled "Bridgeport, Ill." Looking up Bridgeport on the map, myself and friend found it to be only a portion of Chicago, situated on the Chicago River. Taking an Archer Avenue car from down town we soon found the limestone quarries for which we were seeking. At this place the Niagara Limestone crops out, and having been found to produce a very good quality of lime, has been extensively mined and large lime kilns erected.

Having obtained a permit from the office of the Lime Company, we descended into the pit, which, on looking up from the bottom, appeared like a large amphitheatre of rock.

They had just finished blasting before we arrived, hence we found the place most favorable for collecting fossils. For several hours we climbed over the rough masses of rock, hammer in hand and stowed away in a large bag the choice specimens found. The most abundant fossil was an undetermined species of Macrostylocrinus, of which we collected several dozen fine specimens. Next in abundance was the large crinoid *Siphonocrinus nobilis*, Hall, of which we collected eighteen choice specimens, also specimens of the following crinoids: *Eucalyptocrinus chicagœnsis*, *E. rotundus*, *Holocystites alternatus*, and *Caryocrinus ornatus*, Say. The most abundant coral was *Japhrentis Turbinatum*, Hall. We also found *Platyceras Campanulatum*, *Amphicœlia*, *neglecta*, McChesney, Trilobites, Brachiopods, and a very fine Ammonite.

In this way one interested in geology, while visiting Chicago, may fill in an odd day by collecting some interesting specimens. PAUL VAN RIPER.

Niles, Mich.

COON CATS.

SPEAKING of cats, I saw, in a private house in Chicago recently, two cats which the owners called "coon cats." They had been obtained in the edge of the forest around Moosehead Lake, and it was claimed that they were hybrids, or descendants of hybrids of the domestic cat and the raccoon. They were larger than the ordinary house cat, had very coon-like countenances and bushy coon-like tails that were always expanded. One had the habit of ascending something high and resting stretched out, and their motions when in a little hurry were a coon-like gallop.

The claws were retractile, the foot digitigrade. I did not examine the dentition, but could find nothing but appearance that indicated a coon kinship. They interbred with the common cat. Can some one tell me more about them? J. N. BASKETT.

Mexico, Mo., Aug. 28.

DAMAGE TO COTTON BY LIGHTNING.

THE communication of Mr. Frank E. Emery on "Damage to Cotton by Lightning" in your issue of Sept. 8, prompts me to communicate the following facts, bearing directly on Mr. Emery's subject.

For thirty years prior to 1890 some cotton fields at Goldsboro, N. C., owned by the State for the use of the Colored Insane Asylum, have been "struck" by lightning. Occasionally the fields were spared, and then again they suffered two or three times a year. Each stroke would destroy from one-quarter to one-half an acre. The lightning would strike very near the same place every year. In the year 1890 electric light wires were run from the city lighting plant to the Asylum. During the summers of 1890 and 1891 the poles near where the lightning was accustomed to strike, were badly split up. In the summer of 1892 lightning arresters were placed near these points, and since that time there has been no trouble from lightning. Since the wires have been strung on this pole line, lightning has not struck the fields, the wires protecting them perfectly.

These facts are vouched for by a gentleman residing in Goldsboro, who lived on the farm above mentioned before it came into the possession of the State and for the last few years has been manager of the electric plant, thus being acquainted with all lightning troubles that his plant has had to contend with. A. F. MCKISSICK.

Auburn, Ala., Sept. 23.

RHYTINA GIGAS LINN. AT PRINCETON.

IN numbers 522 and 523 of *Science* may be found descriptions of the skeleton of Steller's Sea-Cow (*Rhytina gigas Linn.*) as preserved in the various museums. The Museum at Princeton, New Jersey, has lately come into the possession of a most beautiful set of casts of *Rhytina*, which were obtained from Mr. Robert F. Damon, of Weymouth, England, and are an exact reproduction of the originals found at Behring's Island, and secured by the late Robert Damon, F. G. S., through Dr. Dybowski and presented to the British Museum of Natural History at South Kensington. (*vide* description by Dr. H. Woodward, F. R. S., Quart. Jour. Geol. Soc., 1885, XLI., pp. 457-72). The casts in the Princeton Museum are the following: cranium and jaw (length 68cm) brain cavity, dorsal, lumbar and caudal vertebræ, five cervical vertebræ, atlas and axis, three auditory ossicles, scapula, humerus, radius and ulna. JOHN EYERMAN.

Oakhurst, Easton, Pa., Sept. 22.

SUGAR FROM CORN STALKS.

MR. STEWART'S articles on this subject were intensely interesting and his investigations will doubtless lead to important economic results. As an item of news in this connection I may say that I have a neighbor who made sugar from corn stalks nearly forty years ago. She extracted the sucrose partly by diffusion (boiling the stalks in water) and then by pressure and obtained a sugar nearly white in color and excellent in flavor and sweetening power. A. STEVENSON.

Arthur, Ontario.

"CURIOUS EARS OF INDIAN CORN."

MR. HERSHEY, a recent correspondent in *Science*, speaks of a maize plant producing a cob at the summit of the stalk where we usually find only the tassel of staminate flowers. Such cases, I think, cannot be uncommon, I observed three last year within a small plot of a few square yards. This year a neighbor showed me an even more curious variation of the same kind. The stalk terminated in a spike of about 8 inches long, the upper half of which had contained staminate flowers, while the lower half, which was considerably stouter, contained immature grains. It was in fact a small cob without husks. and the grains were greenish in consequence. Branching off from the stalk at the base of the cobs were two slender pedicels of the remains of staminate flowers. The cob on this specimen contained no staminate flowers, but they were quite numerous on the stunted cobs which I saw last year. A. STEVENSON.

Arthur, Ontario.

EVOLUTION OF SCIENCE TEACHING IN PRIMARY SCHOOLS.

IN *Science*, No. 554, Dr. George G. Groff well shows how insufficient are the means provided in certain professional schools, for properly instructing and training teachers for science teaching in secondary and primary schools. The numerical results of his tabulations certainly place the normal schools of Pennsylvania on the side of tradition as against progress. The ratio of grammar teachers to science teachers is five to four, and the number of teachers of mathematics is approximately that of the teachers of science.

To show that such a state of affairs is not without exception, I will mention the state normal school of Michigan. The faculty of that institution comprises about twenty-five persons (exclusive of the practice school), of whom *four* are assigned to the department of English language and literature, *four* to the department of mathematics, and *six* to the two departments of science. It is not a dozen years since only one teacher was engaged exclusively in science teaching, but the rapid development of science courses, along with specialization of departments, has brought the present gratifying conditions. But what appears to me of much greater significance is the introduction of science teaching into the practice school. The catalogue of that department outlines a course in science studies for the grades one to eight inclusive, making it equally prominent with the other subjects. This course is of necessity rather crude, and the teaching, I venture, is more so, yet the hundred and more young teachers graduated from the institution each year must carry away with them many practical ideas of the new work, gained during their senior year of observation and practice teaching.

Having at hand the catalogues of the several normal schools of Wisconsin and Minnesota, I am pleased to find in them the same evidences of progress. As four or five schools are sustained by each of those states they are necessarily much smaller than the Michigan institution, consequently department lines can not be so strictly drawn around related subjects, and numerical comparisons are not easily made. It is noticeable, however, that the sciences are generally taught by persons who devote their energies entirely to that work. But it is the prescribed courses of the graded practice schools that show best the right tendencies of these institutions.

That science teaching in primary schools falls far short of our "dream" is true. That many successful efforts have been inaugurated is also true. The writer enjoys the personal acquaintance of several energetic young principals and superintendents who have organized science courses in their schools, and can recall numerous instances of teachers who are doing creditable work. A very few cities (Muskegon is the only one known to me in this state) have tried the plan of a special teacher or supervisor of science. Under the present conditions this is doubtless the best plan for cities of sufficient size to justify the expense, provided the person employed is a teacher and not a machine worker. The time and energies of the special teacher should be about equally divided between the pupils and the regular teachers. While doing considerable direct teaching in the school rooms, the best work of this functionary should be the instructing, training and inspiring of the teachers, so that, though they may not become at once ideal exponents of the methods of science, they will at least be more willing and efficient helpers.

The present need in science teaching is not so much in the matter as in the manner. Formal dogmatic teaching of the mere facts of science can only add another burden to the crowded curriculum. Rightly used, no other line of work gives to school life so many points of contact with real life. Observation, investigation, experiment, stimulated and directed by the teacher, should be the directions of greatest activity, and discovery should be one of the chief aims and rewards of the pupil. Instead, the average teacher usually forestalls the best activities of the child by beginning with the announcement of what should be the conclusion.

Where the new work has been introduced it is too often regarded by both teachers and pupils as a strange appendage that has in some way become attached to the body of educational matter. It should and will become a properly related part of the organic body. To change the figure, I know from observation that the announcement "Get ready for the science lesson" means to the pupils "Get ready for the weekly dose of this new educational medicine." Experience shows that it is sweet and pleasant to many; to some it is almost nauseating.

The desired all-round improvement in the preparation of teachers must be a gradual evolution from the present movement. No college or training school course is sufficient in itself. The preparation of the future teacher who shall successfully teach the elements of science in their proper relations to other subjects must begin in the kindergarten and continue throughout, constituting an educational experience in which the teachings of nature contribute their equal share.

The "thinking people" who need no argument that the elements of science should be taught in the primary schools are a small minority. In most instances where teachers or school officers have undertaken the work in a systematic manner they have been permitted by the indifference rather than the active consent of the majority. The advocates of science teaching may well be thankful for this toleration of indifference and should make the most of their opportunity. C. D. McLouth.

Muskegon, Mich.

Birds That Sing in the Night.

The notes which from time to time have appeared in *Science* with reference to the nocturnal singing of birds demonstrate that a considerable number of species are known to exhibit this eccentricity. From my own observations I can corroborate some statements heretofore published, and, I believe, add one or two to the list of daylight songsters guilty of keeping very late hours.

I remember hearing a song sparrow (*Melospiza fasciata*) execute his full song at ten o'clock one dark and cloudy May night in western New York. I listened some time for a repetition of the serenade, but none was given. I have known the catbird (*Galeoscoptes carolinensis*) to sing in the moonlight. During a term of moonlight nights in August I heard the notes of a black-billed cuckoo (*Coccyzus erythrophthalmus*) nightly at frequent intervals for about an hour shortly after midnight. But with the cuckoo this is a well-known occurrence. I have more than once heard at night the twitter of chimney swifts (*Chætura pelagica*) from a chimney.

While on a summer camping expedition in the Cascade Mountains recently I heard cries of the raven (*Corvus corax principalis*) in the darkness, and was awakened on several nights by strange bird notes from the tree tops above our camp. The song—for it might be called such—was presumably executed by some small bird and consisted of a clear plaintive whistle having a tremolo ending. I was at a loss to account for its authorship, for the only bird to be found about the camp in the morning, aside from some woodpeckers, was the Oregon jay (*Perisoreus obscurus*) which I was reluctant to credit with possessing such a voice. However, being as yet unacquainted with the notes of the pygmy owl (*Glaucidium gnoma*) of this region, it occurs to me that the mysterious vocalist may possibly have been this curious little robber.

On two evenings recently at ten o'clock or later I have heard call-notes of some small birds from vacant lots in my neighborhood. They probably came from flocks of migrating finches of some species, whose cries I am as yet unable to identify. They were heard at intervals for more than an hour one evening.

Writing of birds, I am reminded of an incident of another sort which I witnessed a few weeks since. Passing along the margin of a wood my attention was attracted by angry bird notes, which were found to issue from an Oregon junco (*Junco hyemalis oregonus*) and a Vigor's wren (*Thryothorus bewickii spilurus*) which were engaged in a spirited dispute. They made frequent passes at each other as they darted about the branches of a small tree, sometimes the junco and sometimes the wren being the aggressor. Presently a rufous hummingbird (*Trochilus rufus*) appeared upon the scene, and dashing fearlessly at the belligerents quickly put them both to flight. The wren came my way and alighted on a brush pile not ten feet distant, whither he was hotly pursued by the hummer. The latter overtaking him buzzed vigorously about his ears, while the wren with a fuzzled demeanor endured it for a moment and then sought relief in the depths of the brush heap.

J. M. Edson.

New Whatcom, Wash,, Sept. 13.

New Fire from the Lightning Stroke.

Professor O. F. Cook, of Huntington, L. I., who has returned from a journey in Liberia, gave the writer a most interesting account of a custom of the Golas of that country. The Golas apparently do not use fire sticks, but preserve fire carefully. When fire follows a stroke of lightning they hasten to secure a light from it, and putting out all the fires in the village, kindle them again from the new fire.

Lightning is very common in the Gola country, where in certain seasons there are five or six thunder storms in one day.

I regard this one of the most important contributions to the question of the origin of fire, and it shows an unexpected attitude towards the fire from lightning.

Walter Hough.

U. S. National Museum, Oct. 17, 1893.

NOTES AND NEWS.

Mr. L. C. Wooster, who for a year past has been in charge of the Kansas Educational Exhibit at the World's Exposition, has charge of the Science Department in the State Normal School of North Dakota at Mayville. Mr. Wooster has occupied a similar position in the Normal School at Whitewater, Wis.

—Mr. L. B. Avery, who for four years past has been at the head of the Science Department of the State Normal School at St. Cloud, Minn., has accepted the Presidency of the North Dakota State Normal at Mayville.

—The College of Physicians of Philadelphia announces that the next award of the Alvarenga Prize, being the income for one year of the bequest of the late Senor Alvarenga, and amounting to about one hundred and eighty dollars, will be made on July 14, 1894, provided that an essay deemed by the Committee of Award to be worthy of the prize shall have been offered. Essays intended for competition may be upon any subject in medicine, but cannot have been published, and must be received by the Secretary of the College on or before May 1, 1894. Each essay must be sent without signature, but must be plainly marked with a motto and be accompanied by a sealed envelope having on its outside the motto of the paper and within it the name and address of the author. It is a condition of competition that the successful essay or a copy of it shall remain in possession of the College; other essays will be returned upon application within three months after the award.

—Two articles in the November number of the *Atlantic Monthly* will be of particular interest to teachers. These are Horace E. Scudder's "School Libraries," and Ernest Hart's "Spectacled Schoolboys."

BOOK-REVIEWS.

The Science of Mechanics. By Dr. Ernst Mach. Translated by T. J. McCormack. Chicago, The Open Court Publishing Co., 1893. 534 p., 12 mo. $2.50.

This interesting and learned work is the result of a methematician's study of the historical develoment of the science of pure mechanics—the mechanics of the mathematician, as distinguished from the mechanics of the engineer and the artisan. It is a critical and historical exposition of the fundamental principles of mechanics as rendered by Archimedes, Leonardo, Ubaldi, and Stevinus, in earlier times, and by Guericke, Boyle, Galileo, Newton and their successors in recent times. The development of the principles of statistics by the ancients and the improved statements of the same principles by later writers are traced in a very interesting manner. The progress made in the production of a science of dynsmics is similarly exhibited, and the methods of exposition and proof adopted by Galileo, Newton, Huygens and the latter mathematicians are compared in a most instructive discussion. The construction of the science of mechanics, as now defined by the mathematician, is traced historically and logically, and this discussion is closed by a very suggestive chapter on the economy effected by the precision of thought and expression which the science of mechanics illustrates and promotes. The closing chapter on the relation of this science to other departments of learning is pecularly interesting, and is the only approach to metaphysical treatment in the book of any branch of the subject. A table of titles of the works of the great writers to whose treatises reference has been made is a valuable feature. The book will interest every mathematician.

The Locomotive Catechism. By ROBERT GRIMSHAW. Spon & Chamberlain, New York. 362 p. 12mo. $2.00.

THIS is one of those useful little books which are frequently supplied the artisan with the intention of giving him "practical" information in the most thoroughly peptonized form. The catechetic form is given the work in order that every idea may be distinctly grasped and question and answer impressed upon the mind permanently. It is a kind of book which is often much derided; but there is no question in the minds of those most familiar with their field, that they are well adapted to the use of the class of slow readers and inexperienced students to whom they are addressed. Their extensive sale and the fact that an author and his publishers venture to bring into the market a new work in a field already so long and so well occupied by the older and more familiar "Forney's Catechism of the Locomotive" are sufficient proof of a call for them. This little book is full of valuable information for the locomotive driver and his fireman, and for all who are interested in the steam-engine and its construction, even though not professionally. It is freely illustrated and will probably find extensive sale.

Outlines of Surveying and Navigation, for Public Schools and Private Study. By JAMES PITCHER, A.M. Syracuse, N. Y. C. W. Bardeen, 1893. 34 p. 12mo. 50 cents.

THIS litile book is intended to be used as a primer "to give the learner a brief outline of one of the most useful and delightful of occupations." It gives the elementary mathematical theory of the subject, and by the aid of the most elementary mathematics. The book is prepared "for the fireside as well as the school," and will probably find many interested readers and students among the boys on the farm, as well as among scholars in the high schools. The text is well expressed, the examples well chosen, and the illustrations satisfactory. The author concludes: "The foregoing pages have been prepared in the hope of contributing something to the increased intelligence of the boys and girls of our State and nation. Intelligent patriotism and piety will insure the success and the stability of our government"; and he appends Washington's "Farewell Address" as the best lesson in patriotism. Were all books written by authors of the same spirit and of equal patriotism, our boys would profit by the fact greatly, and our country gain commensurately.

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QUERY.

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

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SCIENCE

NEW YORK, OCTOBER 27, 1893.

THE VISITORS TO ONE OAK TREE.

BY MORRIS GIBBS, KALAMAZOO, MICH.

ONE of the pleasures in the study of nature is in keeping a correct record of one's observations for a series of years. Twenty five years ago the writer began a record or list of the birds, mammals and insects seen in a village yard. The lot is five by twelve rods in size, and within this area and over it there have been seen one hundred and thirty-four species of birds, the large majority of which were recorded during the migrations. Of this number nineteen species have been found breeding in the lot.

In this yard are a variety of trees and shrubs, a boundary evergreen hedge, and just outside of it are many surrounding trees. These trees afford resting places for many birds, and during migrations most of those birds which pass through our city of 20,000 inhabitants, usually visit our yard. There is one tree in particular in the lot, a thickly foliaged, low-spreading Burr Oak, *Quercus macrocarpa* well covered with a netting of the common creeper of this section *Ampelopsis quinquefolia*, to which the birds are especially attracted.

During the last decade many changes have taken place in our city lot and the attractions for migrants are not as many as formerly, and furthermore, the former quiet village, now a thriving city, is not invaded by as many of the feathered tribe, as the active migrants prefer the suburbs in their seasonal journeyings. Nevertheless, as the following observations show, many kinds of birds wander into the city, while a few of our commoner species make their home in our midst; some as summer sojourners and others as regular residents or winter visitors.

The oak tree to which I refer stands in our front yard and is readily inspected from the house veranda. At times the tree is alive with birds, and I have often seen three to five species in the branches at once, and on one occasion seven species, including bluejay, robin, yellow-rump, and Tennessee warblers, bronzed grackle, chipping and the ubiquetous European sparrow. The following sixty-four species have been identified while in the branches of the burr oak:

A score of years or more ago the wild or passenger pigeon was known to alight in this tree. The sharp-shinned hawk once accidentally selected the oak in the autumn for a place of observation in his admirable warfare on the pertinacious imported sparrow. Those peculiar and mysterious birds commonly known as rain crows, or more intelligently as cuckoos, are occasional summer visitors, the black-billed quite commonly, while the rarer species, the yellow-billed has been seen but once, but it is becoming more common hereabouts.

Of the wood peckers, five have been seen, the yellow-bellied appears in April and stays a month; red-head and golden-wing straggle into the city and to our tree irregularly from March to November. The hairy and downy wood peckers are not rarely observed spring and fall, the latter often in winter.

Others who visit the oak along with the wood peckers and who feed on much the same kind of food taken from the crevices of the rough bark, are the nuthatches, the white-breast being a resident while the red-belly is a straggler from the north. That mite of flesh and blood, the brown creeper, searches the trunk from base to main fork, and is seen off and on from November to April, often in company with the titmouse or common chickadee. Two other diminutive birds, but not quite so hardy, are the golden and ruby-crowned kinglets which are regular spring and fall visitors.

A not rare winter visitor is the common red crossbill of the north, which occasionally alights in flocks in our oak, and flocks of red polls often come to town. Still another not always recognized northern bird is the little pine siskin, while I have seen the even less known pine and evening grosbeaks. I have also observed the great northern shrike or butcher-bird. The bluejay is a resident and is seen every month in the tree without an exception. The goldfinch is also a resident but is noticed more often in the oak during summer. Snow birds of the slate-colored species and tree sparrows are seen in fall, winter and spring, the former commonly, the latter rarely about our oak. The cedar bird, a resident, yet so erratic in its appearance, may be seen in summer or winter, but never singly, and never to be relied upon.

In the early spring, often in late February the robin and blue bird lend their presence, the former caroling from the topmost branches of the still bare-limbed tree.

The next thrush to show itself is the hermit, which, though usually a ground species, sometimes flies into the lower branches on its way north. Sometimes a cat bird has visited the oak. I once heard a veery's song in the tree, and a dead specimen of the olive-backed thrush lying beneath the branches proved that an unfortunate example of this retiring species had taken the city route and probably been sacrificed to the skill of a boy with an air-gun or sling shot.

Among the spring sparrows I have seen the purple finch, which with the song sparrow often appear before the snow is gone, after which the little hair bird or chippy shows itself. Then follows the white-throated sparrow with its beautiful song which has been likened to the syllables *pea body, pea body, pea body*. Lastly appear the rose-breasted grosbeak and indigo bird of the family, both of which sometimes sing from our oak.

Of the blackbirds the bronzed grackle arrives first, generally in early March, the cowbird appearing the latter part of the month. A meadow lark once paused in its flight accross the city and uttered its stridulous *zeet* from our oak. Next in this family appears that brilliant oriole, Lord Baltimore, and later the plainer relative but sweeter songster the orchard oriole.

In late April the chimmey swifts arrive but do not approach our oak until late May, when inexperienced birds may sometimes be seen to attempt to break off the strong twigs for their stick nests. Humming birds with ruby throats are often seen to alight on the oak which is next to a large trumpet creeper.

The fly-catchers are represented by three species. Kingbirds, common and wood pewees are all visitors, the latter almost daily during summer. That beautiful singer, as well as bird of handsome plumage, the scarlet tanager sometimes wanders into town, and on one occasion I observed one in our oak. The house wren which nests in the neighborhood is often seen.

In the grand rush of migrants which occurs from April twentieth to May fifteenth, and during which time over one-half in numbers of all migrating birds, reach or pass us, we are visited by a large series of birds, mostly small ones, which go further north to breed. The following have been observed in our oak: Nashville, parula, yellow-rumped, black-throated green, Tennessee and Wilson's warbler and the water thrush, while the black and white creeper and Blackburnian warblers remain to nest to some extent in the county.

Among the vireos, three, the warbling, red-eye and yellow-throated, occasionally visit our tree, and all nest in the county. The blue-gray gnatcatcher, although a woodland species, occasionally wanders to our oak.

Three species, the bluejay, robin and chipping sparrow, have rested in this tree during my observations.

It will occupy too much of your space to enumerate the many species of insects which have been found feeding on the foliage or resting on the trunk or limbs of this one tree, but enough observations have been presented to suggest the value of continued notes, even on the visitors to one Oak Tree.

There are many common species of birds which have not as yet been recorded, and many of them are to be looked for and may still be added to the list. A number of birds have been seen which could not be identified, and these instances have always been ignored, the above list being exact.

THE USE OF TUBERCULIN AND MALLEIN FOR THE DIAGNOSIS OF TUBERCULOSIS AND GLANDERS IN ANIMALS.

Shortly after the announcement made by Koch of the effect of tuberculin, the product of the growth of the bacillus tuberculosis, upon man, the idea was suggested that tuberculin would be a very useful agent for diagnosing tuberculosis in cattle. This is often a very difficult matter, and the advantage of a sure method of diagnosis was at once apparent.

While it is probably true that unless the udder of a milch cow is diseased there is but little danger of the milk being contaminated with the consumption germ, the diseased animals even with incipient cases are fruitful sources for the infection of other animals as well as man.

Just to what extent man contracts tuberculosis from cattle and other animals, and *vice versa*, to what extent animals contract this disease from man is not known and would be very difficult to determine. The probabilities, however, point in favor of the fact that cattle are often the intermediate agent in the production of consumption in man.

A small quantity of tuberculin injected into cattle suffering from tuberculosis will cause, in diseased animals, a rise of temperature of two and a half to five degrees Fah., within eight to ten hours after the injection, while healthy animals for the most part do not respond to this test.

A large number of experiments with tuberculin have been conducted, especially in Germany and France, and in general with satisfactory results. Some few cases have been noted where the animals did not respond to the test of tuberculin, but upon section proved to be diseased, while a few others that were not diseased showed a slight reaction with the tuberculin. In the first cases, however, the activity of the tuberculous lesions was not demonstrated by inoculations. It is well known that old, inactive lesions may be found in animals that have been slightly diseased and recovered. In the second cases the autopsies have not always been sufficiently close to prove the entire absence of disease, as there has not been an examination of the bones and spinal column. It is further possible, that the cause of infection might be present in the animal without having reached a sufficiently advanced stage for lesions to be apparent.

With a view of making tuberculin of practical value and eventually stamping out consumption among cattle, the Department of Agriculture has begun a series of experiments, and the report of the Secretary of Agriculture for 1892, recently issued, contains a statement from the Biochemic Laboratory of the Bureau of Animal Industry, of some of the results obtained. In this laboratory a number of tests have been made as to methods of manufacturing tuberculin, and the Bureau has been prepared, for some time, to furnish tuberculin of its own manufacture to Boards of Health, Experiment Stations and State Veterinarians, for practical use.

In addition to these experiments this laboratory also manufactures Mallein, obtained from the growth of the bacillus malleus. The mallein is used for diagnosing glanders in horses and has proved exceedingly valuable. Through the efforts of the Bureau of Animal Industry, this product has been widely distributed in the States, and its use in different hands has proven very satisfactory. In many instances, by its means, the disease in apparently healthy horses has been detected and by the destruction of the animal the source of infection for valuable stock removed and considerable property saved.

As the tuberculin and mallein are made thus under government control and in one laboratory, the product is uniform in character, and can be prepared at a very much less cost than the imported tuberculin can be purchased. By the use of these two diagnostic agents the Department hopes to be able to do a great deal in the way of exterminating two dangerous diseases. Whether or not it would be practical to stamp out tuberculosis among cattle by killing all diseased or suspicious animals, is a question, but it would be possible by the use of tuberculin and proper sanitary regulations to check the advance of the disease and confine it within prescribed areas.

It is along this line of investigation that advance in the future, in human and veterinary medicine, will be made, and the Department of Agriculture in looking to a control of tuberculosis and glanders is keeping in view, not only the best interests of the agricultural classes, but of the people in general. "Bios."

NOTES AND NEWS.

It has been said that "the little red schoolhouse" was the corner stone of American civilization, and from the very force of sentiment and historical memories the country school of New England retains its hold upon thousands who may have never entered its doors In "The Country School in New England," written and illustrated by Clifton Johnson, the author describes the winter and summer terms, the scholars in their classes and at the blackboard, their punishments, their fishing and coasting, their duties and amusements on the farm—in short, the every-day life of the boys and girls of rural New England in the days of our fathers and our own. Every phase of his subject is aptly illustrated with pictures from life. There are over sixty illustrations in this book, which is to be published immediately by D. Appleton & Co.

—A scientific session of the National Academy of Sciences will be held in Albany, in the Capitol, Nov. 7, beginning at 11 A. M. Members who have papers for this meeting may send the titles to Prof. Lewis Boss, Dudley Observatory, Albany, New York. A special stated session of the Academy is called for Wednesday, Nov. 8, in Albany, to consider the President's Annual Report to Congress, and other business that may come before the Academy.

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

MENTAL IMAGES.

BY E. A. KIRKPATRICK, WINONA, MINN.

SPENCER, in his "Philosophy of Style," decides in favor of the English custom of placing the adjective before the noun because when the word "horse," for example, is pronounced, there tends to arise in the mind a mental image of a horse, probably of a brown color, since that is most common, and when the adjective "black" follows, as in French, this image must be changed, producing hindrance. While listening to a recitation upon this well-known passage, in a high school, the question came to me: "Do people form distinct mental images when words are spoken?" I immediately obtained permission to test the matter there and later in the grammar school and in a college in the same town.

The following ten words were selected and pronounced, one at a time, the pupils being requested to write down just what came into their minds when the words were spoken: "church," "book," "drum," "tree," "horse," "dog," "chair," "stove," "man," "lamp." They were told to give the size and color, if it were visual, and if it was something heard or felt to state that fact.

The answers were various, and of all grades of distinctness and vagueness, so that the task of classifying them was very difficult. This standard was finally adopted. If the writer mentioned the size and color of the object, or named an individual or species of the general class indicated by the word, his mental image was counted as a distinct mental image, otherwise it was not. Three classes of visual images were found: (1) distinct, including all that conformed to the standard given above; (2) particular, including those of the above that were of particular or individual things; (3) indistinct images, or none. The auditory and tactile images, which were very few in number, were classified separately.

The general results for the different grades of pupils and classes of students, and the sexes are shown in table I.

It will be seen from the general average that for those persons and those words distinct visual images were found in about three-fourths of the cases. The conditions were much more favorable, however, for forming mental images than are present in ordinary reading or listening. More time was allowed between the words. A tendency to form mental images was excited by the preliminary remarks, and the fact that they were to write something tended to make them form more distinct men-

TABLE I.

	Grammar School						High School										College Students								Gen. Aver.	
	7th G.		8th G.		Average.		9th G.		10th G.		11th G.		12th G.		Average.		Fresh.		Junior.		Senior.		Average.			
	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.
No. of Persons,	12	12	13	18	25	30	22	22	21	22	9	7	8	3	60	54	14	32	13	21	16	21	43	74	128	158
Dist'nct Im'g's,	8.51	7.08	7.61	7.72	8.04	7.46	9.13	8.18	8.23	7.36	8.00	7.71	9.12	4.66	8.65	7.64	7.42	6.96	6.30	6.75	6.06	5.90	6.58	6.74	7.83	7.19
Particular,	2.75	2.91	3.07	4.50	2.92	3.66	2.40	3.00	4.00	4.27	3.00	4.14	3.00	2.66	3.11	3.68	2.85	2.77	1.77	3.75	3.75	2.23	2.86	2.90	2.21	3.36
Ind'stn't or N'ne,	.91	2.25	2.07	2.16	1.52	2.20	.76	1.68	1.66	2.50	1.99	2.00	.87	5.33	1.25	2.29	2.28	2.68	3.15	2.35	3.56	3.57	3.02	2.85	2.21	3.36

tal images. In a subsequent experiment upon about two hundred normal students, when more care was taken not to make the preliminary explanations suggestive, the number of distinct mental images was about ten per cent less, and in the case of four hundred school children considerably less than that, but in this latter case many did not understand what was wanted. When particular things are thought of the descriptions may have been given from memory, in some cases, without any distinct mental image being present, but the general term was, at any rate, translated into a particular thing which represented the class. These results do not prove that in reading three-fourths of the names call up distinct mental images, but they indicate that in a large proportion of cases there is a strong tendency to form such images, which is probably often effective in slow, careful reading.

It will be seen that the females show a stronger tendency to form mental images than the males. This is especially evident when the particular images, which are less surely distinct, are not counted. The numbers in each grade or class are so few and the ages of the members in each so different that not much importance can be attached to the differences shown in the table. It is significant, however, that among the college students, where, all being adults, age is a less important factor, and where each year they take up more abstract subjects, the tendency to form distinct mental images decreases from the lower to the higher classes. Galton, in his study of mental imagery, found that some eminent men who had spent many years in abstract studies, were utterly unable to form distinct mental images. On the other hand those who deal much with objects sometimes form mental images as distinct and vivid as the original, as, for example, the painter mentioned by Taine, who looked at his subjects when sketching the general outline, then filled in the details from the mental image he had formed.

The results classified according to the age of the subjects are given in table II:

TABLE II.

No. of Persons, (Females), -	3	5	14	21	24	9	14	6	3	2	9	8	7
Age, - - - -	12	13	14	15	16	17	18	19	20	21	22	23	24
Distinct Images, - -	7	8	8.71	8.66	7.33	8.77	7.83	7.83	8.33	4.50	6.44	5.12	6.00
No. of Persons, (Males), - -	4	8	20	16	16	7	11	18	18	7	7	5	8
Distinct Images, - -	8.25	8.75	6.75	9.05	7.47	5.00	8.00	6.88	7.00	6.85	6.40	6.83	4.37

In the case of boys of fourteen and seventeen years the average is cut down by the fact that there were several who formed no distinct mental images, though it would have been low anyway, and in several other cases the numbers are so small that only slight importance can be attached to the figures. The very high average for boys of fifteen is quite suggestive. The average for girls of fourteen is also high. It is well known that great changes take place during the period of adolescence, especially in the boy. It has been shown that it is a period of rapid growth and good health, and that it is preceded and followed by short periods of slow growth and poor health. Recent experiments have also shown that at this period there is a rapid increase in the rate of voluntary motions. These figures suggested that perhaps the same law holds for the formation of mental images as for growth, health and motion. I accordingly repeated the experiment upon about four hundred more school children. The results for boys from thirteen to seventeen were as follows:

	13	14	15	16	17
	3 7-12	3	4 10-29	3 9-29	2 3-11
and for girls:	4 8-33	3	3 1-2	3 7-23	3

I arranged in marking the papers so that I should not know the age of the subject whose answers I was classifying, hence my judgment could not have been influenced by my theory. The large number of distinct images formed by boys of fifteen compared with those of other ages, especially fourteen and seventeen, is again very marked. There is considerable probability that the law of change in the tendency to form mental images is somewhat like this. The tendency to form mental images decreases just before the period of adolescence, increases very rapidly early in that period, decreases at its close, then increases or decreases according as the occupations and studies favor or oppose the tendency. More extensive experiments and more exact methods will be required to demonstrate the law.

The words used were not all equally effective in calling up mental images, but the difference is not very marked.

Table III shows the per cents for the different words with the high school pupils:

"Church," being the least general term in the list, produces the most distinct images, but a large proportion of them are particular, usually of the one the writer attends. The following are typical answers: *School Children*—"Methodist church front door," "Congregational church with a large crowd singing," "A country church with a steeple," "A large white church with people going in and out," "Word 'church' printed," "A little white church on a hill in Ovid." *College Students*—"A gothic building with spire," "A generalized type of a church building," "Pictures of the exterior color somewhat dull," "Interior of the church I have attended the later years of my life, the people gathered," "A religious organization," (none of the school children gave this answer) "Sermon or religious service," "The image of several churches in succession, the Congregational first," "A white church with a spire in the corner," "First an edifice capped with a spire, then a preacher standing before his audience," "Congregational as seen from the library this morning," "Congregational views from the N. E.," "White building longer than wide, with green shutters and a spire." "A common country church building," "Image of a light stone church situated on a hill."

Book ranks next to *church* in the number of distinct and particular images called up. The particular image most frequently suggested was of the book from which the pupil was to recite next.

School Children.—"Leaves of a reader," "Circuit Rider," "Study," "A real good novel" (how suggestive this answer), "Longfellow," "Small colored white and brown," "Daniel Webster's dictionary" (!), "Bible," "See a large red book full of poems on the table," "Large, with gold edges," "Scottish Chiefs," "A large dictionary on a rack," "The knowledge one would have if he could tell all the important events in history." *College Students*—"Reading school," "The ordinary book form," "Food for the mind," "General idea of a book," "The thoughts of some person," "Picture of a book closed," "An object which contains printed matter," "Indefinite, stiff cover, open," "A 12mo. bound in cloth, black in color," "Indistinct form of a book," "Hawthorne's *House of Seven Gables*," "A small black book."

TABLE III.

Word, - - -	Church.		Book.		Drum.		Tree.		Horse.		Dog.		Chair.		Stove.		Man.		Lamp.	
Sex, - - -	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.
Distinct Images, -	89.5	86.6	73.0	82.7	79.0	80.0	87.0	70.0	82.0	76.6	79.0	77.3	73.5	66.6	82.0	66.6	80.5	70.0	81.0	72.4
Particular, -	76.2	76.6	58.0	66.6	29.0	46.6	26.5	43.3	24.0	30.0	18.0	36.6	18.6	33.3	16.0	36.6	40.0	60.0	16.0	36.6
Indistinct or None,	10.5	13.3	27.0	17.2	16.0	13.3	13.1	30.0	18.0	23.3	20.5	26.6	26.5	33.3	16.0	33.3	19.4	30.1	19.0	27.4

The numbers indicate per cent.

The word drum called forth remarkably few auditory images. The Salvation Army drum which had been carried through the streets every evening for some time was most commonly thought of, the image usually being visual. Drums in certain bands were next most common. *School Children.*—"Circus parade," "Large base drum with sticks on it," "Small, with a very pretty girl playing," "Small drum with silver bands," "An army," "Ear drum," "A little drummer boy in a crowd and fifers." *College Students.*—"A large noisy instrument with a man or boy attachment," "My little brother using his drum," "Picture in mind of a drum, size medium, red trimmings, stretched skin across the top, cord on the sides" (evidently this image became distinct as the writer wrote the description), "My little cousin and his drum, auditory as well as visual," "A big base drum with a man pounding on it," "A band walking the street," "Drum of my native city with name of town in black letters," "An old drum I had in my childhood," "Noise and Fourth of July procession," "Form [?] and their sound," "Image of a child's drum with red ornaments."

The word *tree* called forth images of nearly every kind of tree growing in that region and some that do not. The maple was most frequently mentioned by the school children, probably because they were specially interested in it at that time of year. The particular trees were usually of the school grounds, the college campus, or the yard at home. Although the trees were bare at that time, many of the images were of trees in full leaf.

School Children.—"Maple tree tapped, with a sap can," "The cherry tree that George Washington cut down," "Tree of life," "A maple tree tall and straight, but leaves withered," "I fancy I am sitting under it in summer time eating apples," "A tall tree with spreading branches," "An apple tree in blossom," "A tree without leaves, maple, I think," "Big trees in California." *College Students*—"A representation of vegetable life, something growing," "Green leaves and shade," "That of a dream I had last night," "A particular tree which, when I began drawing lessons, I pictured," "Hear the rustle of the leaves moved by the wind," "Mass of foliage," "A symmetrical body," "Leafless trees, bare branches," "A large stately oak."

The word *horse* called up images of horses of all sizes, ages and colors, the particular horse thought of usually being that belonging to the family.

School Children.—"Axtell" (the noted Iowa trotter), "A bay horse attached to a red-wheeled buggy," "A horse with wings," "Geo. H. trying to hold a runaway horse," "Maud S," "Black horse in a red barn," "A black horse going at full speed," "The horse I draw pictures of," "Team I saw this morning." *College Students.*—"A black horse in a pasture," "Picture of a horse with a fine-shaped head and curly mane," "One which I saw loose on the street yesterday," "A horse travelling very fast," "Visual image of the word *horse*," "A large bay horse; I used to work with such a one," "A span of gray horses, not particular," "Pony with a saddle," "A vague image of a horse trotting down the road," "Horses struggling with a heavy load."

The answers given above are typical of the kind of answers given for the other words.

The question of what determines what one of the many possible mental images shall be called up at any particular time by a word is a very interesting one. One would naturally think, as Spencer suggests, that the image of the object most often seen would be the one called up and used to represent the class. In many cases this is true. The particular images, however, are often of objects recently seen. Again, the effect of early association is prominent, *e. g.*, a college senior thought of the high chair he used to occupy. In other cases intensity of the impression produced by its novelty, oddity, or some emotional accompaniment, seems to be the principal cause.

It may be asked, Is it not entirely uncertain what kind of a mental image an individual will form when a word is spoken? May it not be of one kind at one time and of another the next hour or day? Galton tested himself several times under entirely different circumstances and was astonished to find in what a large proportion of cases the same thing was called up by the same word. In order to test this matter I repeated the experiment upon the senior class after an interval of a month, during which there had been a ten days' vacation. Twenty-three papers were obtained of those who had been tested before, and the answers were classified. The results were very much the same as in the first test. In the case of distinct images, not particular, the results were almost identical. thirty-five such images being called up in the mind of the boys the first time and thirty-three the second, and twenty-four both times in the minds of the girls. Upon comparing the two sets of papers individually, I found that forty per cent of the answers were identical and ten per cent were nearly so. The greatest variation was in the case of particular images, especially where recency was the principal factor in producing them. Yet I found that where one formed particular images in one case he did in the other, though often of a different thing. Those who formed distinct images in the first case did in the second, and those who formed none, or vague ones, in the first case, did the same the second time. I was surprised at this result and my confidence in my experiments very much strengthened by it. It shows that the mind works according to fixed laws, and justifies one in believing that the kind of mental images one forms are just as characteristic of his mental organization as his features and gestures are of his bodily. Were we accurate observers of mental phenomena we could recognize the language and thought of a friend as readily as we can his handwriting.

The individual differences in the tendency to visualize vary greatly and form an interesting study. They play an important part in the mental processes of some, while others do not use them at all. For convenience, we may divide people into two classes—the non-visualizers and the visualizers. So far as could be determined there is no more reason to expect one to be intelligent than the other. The following answers from two seniors illustrate two types of the first class. The first is from a rather dull student who forms concepts instead of images, the second from one of the keenest reasoners in the class—a "relational" thinker who thinks not of the thing named, but of some related thing:

Church, a religious organization.
Book, an object which contains printed matter.
Drum, a large musical instrument (round).
Tree ——
Horse, a large quadruped.
Dog, a very friendly animal.
Chair, an object generally composed of wood, used for comfort.
Stove, an iron—
Man, a being made in the image of God.
Lamp, a glass object containing a wick and oil, which is used in giving light.

Church, pews, pulpit.
Book, leaves, intelligence.
Drum, a noise.
Tree, a symmetrical body.
Horse, a beast of burden.
Dog, household pet, fights the cat.
Chair, a comfortable lounging place.
Stove, a cooking apparatus.
Man, the crown of creation, the complement of woman.
Lamp, gives light unto all that are in the house.

Of the visualizers some nearly slways form distinct visual images, either general or particular, others do not always do so spontaneously when a general term is heard, but can at will. The following answers show that the writer thinks in visual images, but the images are not generally very distinct.

"Church—A particular building in another town where a certain event took place. Book—General image. Drum—An image of a drum. Tree—The image of a general tree, not any particular one. Horse—An image of a former horse of my own. Dog—Image of the general form of a dog. Chair—Image of the general form of a chair. Stove—An image of a hard-coal burner with a fire. Man—General image."

The following are the answers of a young lady who always thinks in visual terms and who generally uses the same images for the same notion.

"Church—White wooden building with spire rising from the front. Book—Image of a book, always of a dark gray color. Drum—Probably image of the first one I ever saw. Tree—Very similar to the toy tree that came with Noah's Ark. Horse—A white or dappled gray horse, always prancing. Dog—A black Newfoundland. Chair—Common cane-seated oak chair. Stove—Image not well defined. Man—Not particular, idea. Lamp—Greasy little lamp with glass globe."

The extent to which visual images predominate in most minds is quite surprising. Only about three per cent of the distinct images called up by the ten words in the list were other than visual. In a subsequent experiment upon 227 normal students 2.4 per cent of the images were auditory and 1.2 per cent tactile and motor. This does not mean that 96 per cent of these people are eye-minded to such an extent that they cannot form anything but visual images, but it shows the proportionate strength of the tendency to represent everything in visual terms.

The power to visualize (not the spontaneous tendency to do so) and the power to form auditory images were studied in another way. The normal students mentioned above were asked to think of the breakfast table at which they had sat that morning, then they answered questions as follows: (1) Have you a distinct image of it? Yes, 211; No, 10. (2) Is each object well defined? Yes, 183; No, 20; Part, 15. Do they appear in their true color and brightness? Yes, 167; No, 36; Part, 13. (4) Do they seem at a definite distance? Yes, 173; No, 43; Part, 3. (5) Can you mentally hear the voices of your companions as distinctly as you can see their faces? Yes, 84; No, 108; Part or almost, 22. These answers are very interesting, but too much importance must not be attached to them, especially the first. Paradoxical as it may seem, a person is a very poor judge as to the distinctness of his own mental images. I am convinced that persons who usually form very distinct images are as likely to say of any particular image that it is not distinct as one who has the power to form only the vaguest images. Each answers according to his own experience and standard of judgment, and the "vague image" of one may really be much more definite and vivid than the "distinct" image of another. An objective test and standard of judgment applied by some one else will give more accurate comparative results.

The relation of mental images to all psychical processes and to pedagogical problems is very interesting and important. Their relation to memory is peculiarly close, and a number of experiments to determine it were made but cannot be reported in this article.

INMUNITY AND CURE IN THE INFECTIOUS DISEASES.

BY VICTOR U. VAUGHAN.

Immunity may be natural or acquired. Natural immunity may be peculiar to the species or race, or to the individual. An example of natural immunity is that of the domestic fowl to anthrax. This animal, even at the time of coming from the shell, is immune to even the most virulent cultures of the bacillus anthracis. It is true that the chick may be made susceptible to anthrax, but this is an artificially induced susceptibility. Immunity is natural to this bird at every period of its life.

The natural inmunity which is peculiar to the individual usually comes with adult life. The young are susceptible to a given disease, but adults of the same species lost this susceptibility and become immune. The young rat is susceptible to anthrax, while the adult is naturally immune, but can be rendered susceptible by exhaustive exercise. The child is highly susceptible to scarlet fever and diphtheria, while the adult, though not wholly immune to these diseases, loses very much in susceptibility and is likely to become affected only when greatly reduced in vitality, or after prolonged and aggravated exposure to poison. The evolution of the condition of immunity in these cases is due to the natural development of the functional activity of certain cells of the body. A child and an adult are exposed to the bacillus of diphtheria from the same source. The former becomes affected, the latter does not. The germ is the same, but in the development that converts the child into the adult, the resistence with which the germ must contend has been strengthened. Artificial immunity may be induced by either of the following methods :

1. By an attack of the disease ending in recovery. Until the discovery of Jenner, this was the only known cause of immunity, and even at present it is supposed to be, as far as man is concerned, the most potent cause. It is true, I believe, that the more grave and virulent the disease may be, the greater and more persistent is the immunity that follows. I mention this in order to call attention to the fact that there is a quantitive relation between cause and effect in the production of immunity. In this method of inducing immunity, the substance of the germ itself is introduced into the body. This method found a practical application in inoculstion for the prevention of small pox.

2. By vaccination with a modified and less virulent form of the infection, or by the introduction of at first a very small number of the virulent germs and successive inoculations with larger numbers. The successful inoculations against chicken cholera and anthrax made by Pasteur consist in vaccination with a modified germ, and the valuable investigations of Emmerich and his students in immunizing certain animals to swine erysipelas have demonstrated the results that may be obtained by employing the virulent germ, first in small numbers, and then gradually increasing the doses. Again, it may be observed that the germs themselves are introduced into the body, and again it is also true that the more potent the cause, the greater and more persistent the effect.

3. By one or more treatments with sterilized cultures of the germs. Immunity against the gems of typhoid fever, cholera, dptheria, tetanus, hog cholera, and several other diseases, has been secured by one or more treatments witn sterilized cultures of these germs. In answering the question, which constituent of sterilized cultures gives inmunity, we must bear in mind the following facts.

a. Marked artificial inmunity to the infectious diseases has not been obtained except by the introduction into the animal of the gem substance, either enclosed in the cell wall or in solution.

b. Sterilized cultures contain the germ substance in one or both of these forms.

c. The same immunizing substance exists in the bodies of bacteria grown on solid media and killed by the action of choloroform.

d. The same immunizing effects, varying, however, in degree, are obtained with the bodies of dead bacteria morphologically intact or in solution, with living bacteria modified and reduced in virulence, and with very small numbers of the virulent germ.

With these demonstrated facts before us, I am ready to believe that the immunizing substauce is a constituent of tne bacterial cell itself, and as each kind of germ has its own peculiar poison (which in small doses confers immunity), this poison cannot come from the cell wall; nor is it really a split product of tne germ's action, but it is the essentially characteristic part of the cell--that part wnicn gives to tne germ its distinctive properties. I believe that it is the nuclein.

The three methods of inducing immunity which we have mentioned reduce themselves to one and the same principle, i. e. the introduction of germ nuclein into the body.

The immunity that results from an attack of the disease is caused by the introduction of germs living and more or less virulent. That which comes from vaccination is due to the introduction of germs living but modified and reduced in virulence, or administered in small quanity; that which is obtained by one or more treatments with sterilized cultures is secured by the introduction of germ nuclein so modified that it is no longer capable of reproducing itself.

4. By treating a susceptible animal with the blood serum of an immune animal.

Strange as it may seem, the principle upon which immunity is secured when the blood serum of an immunized animal is injected into a susceptible one is essentially the same as that which holds good in the methods already discussed. A horse is rendered inmune to tetanus by previous treatment with the modified bacterial proteid of that disease. As a result of these treatments, a tetanus antitoxin is generated in some organ or organs of the horse and circulates in its blood. When the blood clots, this antitoxin is found in the serum, and if the s serum be injected into a mouse in sufficient quanity, this animal becomes for the time being immune to the tetanus poison, provided that the poison is not introduced in quantities so large that it will not be destroyed by the antitoxin that has been brought over from the horse. The immunity actnally does nor belong to the mouse, it still belongs to the horse. It is stolen property and will soon be lost. The cells of the horse and not those of the mouse make the antitoxin. The mouse for the time being becomes physiologically a part of the horse, and it is by virtue of this relationship that the former is for the time being immune to tetanus.

We have seen that in all cases the cause that brings into existance the condition of immunity is a bacterial proteid. Nnw, in order that this inciting cause may induce the condition of immunity, it must act upon something. Upon what organs of the body does it act? We have many reasons for believing that the organs acted upon are, the spleen. bone narrow, thyroid and thymus glands, and possibly other grandular organs. Tizzoni and Cattani have found that rabbits from which the spleen has been removed cannot be immunized to tetanus. Supposing that the above mentioned organs are concerned in the production of immunity, in what way do they act? Do they elaborate antitoxins, and if so, what can be said about the natnre of these antitoxins? These are questions in which I have been deeply interested for some time, and which I have attempted to solve. In this attempt, I have born in mind the fact that these organs are the source of the nucleated white blood corpuscles. Do these corpuscles contain a germicidal or antitoxie substance, and if so, what is its nature? The chief chemical constituent of nuclei is a substance called nuclein, some of the general properties of which are known to physiological chemists. Can it be that nuclein is the germicidal or antitoxic substance? Have the nucleins in general or as a class any germicidal action? As methods of insolating the nuclein are known, these questions can be answered by experimentation, and this I have attempted to do.

At first I tried to prepare an active nuclein from compressed yeast, but the results were not satisfactory. Compressed yeast contains a large amount of water and starch. The large proportion of the first mentioned constituent caused a very small yield of nuclein, and there were many dfficulties in the complete separation of the starch. There were, however two other and more serious objections to the use of compressed yeast. The first of these is due to the fact that such yeast contains bacteria to begin with, and the nuclein contained in this yeast has already been decomposed. The second difficulty lies in the fact that compressed yeast contains many dead cells, and an active nuclein can be obtained only from living, healthy cells.

From the cells obtained from pure cultures of yeast, I have obtained an active nuclem by the following method:

The cells from pure cultures of yeast are washed with sterilized water, then treated with a five per cent solution of potassium hydrate and filtered through paper. Sterilization of the paper is not necessary. The filtrate is feebly acidified with hydrochloric acid and the proteid precipitated with 96 per cent alcohol. The precipitate is washed with alcohol by decantation until the supernatant fluid remains colorless. The precipitate is then collected upon a filter, and after all the alcohol has passed through, it is dissolved in very dilute potassium hydrate (.25 to .50 per cent). This inquire nuelein hes marked germicidal effects upon the staphylococcus pyogenes aureus, albus, the anthrax bacillus, and the germs of typhoid fever, Asiatic cholera, and tuberculosis.

The following experiment will illustrate the action of this nnclein upon the bccillus of tuberculosis: A loop of tuberculous sputum, showing from 40 to 60 bacilli in each field when stained, was stirred up in beef tea, allowed to stand for twenty-four hours at 38° C. and injected into the abdominal cavity of guinea pig No. 1. Another loop of the same sputum was added to a solution of 30 milligrams of inpure yeast nuclein in .08 per cent of potassium hydrate, and this was allowed to stand in the incubator at 38 degrees C for twenty-four hours, and then injected into the abdominal cavity of guinea pig No. 2.

At the expiration of fourteen days, both of those animals were killed. The omentum of No. 1 was a tuberculous mass throughout, while No. 2 showed not the slightest evidence of the disease.

I have prepared testicular nuclein from the testicles of of the bull, dog. guinea pig, and rat. The testicles are stripped of their investing membranes as soon as removed, rubbed up and extracted repeatedly with a mixture of equal volumes of absolute alcohol and ether. Then, the testicular snbstance is digested for some days (until the supernatant fluid fails to respond to the biuret test for peptones) at 40 degrees C. with pepsin and .2 per cent hydrocoloric acid. The undijested portion which contains the nuclei is collected on a filter paper and washed, first with .2 per cent hydrochloric acid, then with alcohol. Finally it is dissolved in a .5 per cent solution of potassium hydrate and filtered through a Chamberland filter without pressure This solution is clear, more or less yellow, and feebly alkaline. On the addition of nitric acid, a white precipitate forms and dissolves colorless in the cold on the further addition of nitric acid. This nuclein does not give the biuret reaction, but does respond to the Millon test. The nitric acid solution of the precipitate becomes yellow on the addition of ammonia. This nuclein also has germicidal properties, as is demonstrated by the following experiment:

A solution of testicular nuclein of unknown strength, obtained from the testicles of a bull, was diluted with four volumes of physiologic salt solution, inoculated with the bacillus anthracis, and plates made with the following results;

Time,	Immediate.	30 min.	1 hr.	2 hrs.	3 hrs.
Number of colonies,	730	6	0	0	0

Other nucleins with germicidal properties have been obtained from the thyroid gland, spleen, and from the yolks of eggs.

These experiments render it highly probable that the nuclein-forming organs of the body have some concern in the production of immunity. The nucleins formed by these cells or in these organs pass into the blood partly in the form of multinuclear white corpuscles—the so-called phagocytes.

In order to state my views upon immunity in a condensed form, I will summarize as follows: There must be three factors in the production of immunity in an animal naturally susceptible: First, there must be an inciting or immunizing substance introduced into the body. This substance is the nuclein of the germ. These nucleins, when introduced into the bodies of certain animals, in certain amounts and under certain conditions, have the property of so stimulating the activity of certain organs that those organs produce and supply to the blood an antidote to the substance introduced.

Secondly. The organs whose activity is stimulated by these immunizing agents are those such as the spleen, thyroid gland and bone marrow, which manufacture nucleins.

Thirdly. The antidotal substance is a nuclein. The kind and amount of nuclein formed will depend upon the nature of the inciting agent and the condition of the organ or organs acted upon.

I use the word "nuclein" in a broad sense, including the true nucleins, nucleinic acid, and nucleo-albumins. By the term "nuclein" I mean that part of the cell which under normal conditions is endowed with the capability of growth and reproduction, which assimilates other proteids and endows these assimilated substances with its own properties. It is that part of the cell which gives in its individuality. Whether these nucleins while in solution and devoid of morphologic unity are still capable of assimilating allied bodies cannot at present be satisfactorily determined.

We can suppose that the process of immunizing an animal proceeds in something like the following manner:

The modified virus of tetanus is introduced into some distant part. In some unknown way, the spleen is stimulated to action and secretes a nuclein which is carried partlp in solution, partly in the form of multinuclear cells, to the invaded party of the body, and the tetanus poison is converted into the nuclein coming in contact with it, or is otherwise rendered inert. Later, a larger quantity of the tetanus poison is introduced, and now the acspleen ts more promptly and energetically than before. This promptness and energy of action are increased by exercise, and finally an amount of tetanus culture of full virulence, sufficient to kill an animal whose spleen has not been subjected to this training, may ba introduced without ill effect.

On this theory, the production of immunity consists of a special education of certain cells and artificial immunity becomes essentially cellular. The differance between immunity and tolerance I conceive to be this: In the former, the of certain organs become aggressive, a special function is developed. The poison introduced is destroyed. In tolerance, there is no aggressive action on the part of any organ.

There is no development of speeial functions. The poison introduced is not destroyed, it only fails to kill.

Now what can be said about the relation between thc principles of immunity and those of cure? Are they the same? I think that there are essential differences. In the first place, the substances with which inmunity is induced are not applicable in the production of a cure. They are already in the body and have failed to stimulate the nuclein-forming cells in such a manner as to cause their own destruction. To introduce more of the bacterial poison after the invading virus has established itself in the system will only strengthen the invader.

If I am right concerning this differance between the agents of inmunity and cure, to what source shall we look for curative substances in the infectious diseases? Either we must introduce into the body some germicide formed by other cells, or we must employ other agencies for the purpose of stimulating the nuclein forming cells.

Blood-serum therapy offers the first of these alternatives, and now that we know that the germicidal constituent of the blood is a nuclein, blood-serum therapy will give place to nuclein therapy, and with the latter there is more hope of accomplishing good results because it reduces the size of the dose.

Now that we have learned that the animal body itself generates a germicide more powerful in its action than corrosive sublimate, and since we know how to increase the amount of this substance in the blood and can insolate it and inject it into other animals, a new theory of the treatment of diseases is opened to us.

If it be possible to kill the germs or destroy thc bacterial poison after the development of an infectious disease, by the introduction of a germicde or a toxicide formed by other cells than those of the infected person, then we may expect that cures for diseases of this kind will be found in the near future. Experimentation offers the only means of ascertaining whether or not this be possible. The recently reported cases of tetanus successfully treated with the antitoxin of Tizzoni and Cattani, obtained from the blood of animals which have been rendered immune to this disease, are in accord with this principle.

If nuclein therapy fails us, we must strive to find agents that will stimulate the nuclein forming glands. This probably is the shief factor in the climatic treatment of tuberculosis, but so far as our knowledge of medicinal substances that will accomplish this result goes, we are practically and wholly ignorant.

I have used the "cure," limiting its meaning to the destruction of the germ or other poison. If we could destroy all of the bacilli in the body of a tuberculous patient, would a cure be effected? If we ever reach this desideratum. nature will probably do the rest.

CONSCIOUSNESS UNDER THE INFLUENCE OF CANNABIS INDICA.

BY E. W. SCRIPTURE, YALE UNIVERSITY, NEW HAVEN, CONN.

The statement is generally madc that the extract of *Cannabis Indica* (flowers of the Indian hemp whose leaves and resin furnish hashish) causes time and space to be greatly lengthened in consciousness. Wishing to know what is meant by these statements I obtained the prescription:

Rx.
Ex. Cannabis Indicæ 1 oz.
(P. D. & Co.)
Alcohol 20 oz.
M. Lig. Alcoholic solution of extract of Cannibis indica. One drachm contains three grains. Commencing dose ten drops containing one-quarter grain of the extract.

One evening I took ten drops as prescribed. No effects were noticed for over 45 minutes. Concluding that the dose was not strong enough I gave up the experiment for that occasion and drank a mug of beer preparatory to retiring. The narcotic action of the hops probably assisted in bringing on the effects of the dose. It is to be noted that my consciousness is very suspectible to the influence of narcotics.

For over an hour and a half, till final sleep occurred, and in a lesser degree throughout the next day, several important changes in mental life were observed. The most striking was the fluctuation of attention. The experiments of Lange (Philos. Studien, IV, 390) and of Eckener, Pace and Marbe (Philos. Stud., VIII, 343, 388, 615) have demonstrated the phenomenon as a normal condition for weak stimuli. For example, the faint ticking of a watch is alternately lost and heard. It holds good also of stronger sensations; the ticking of a clock, although loud, will vary in its apparent intensity. The immense fluctuations under the influence of hemp can be illustrated by the following case which occurred several times. A horse car is heard approaching; shortly afterward I find that the sound enters anew into consciousness; again it enters anew, and this is repeated through all the phases of approach, passage and retreat of the car. While listening to the sound, it somehow slips away, just as in Lange's experiment, and returns after a while. In describing the phenomenon I have avoided saying that the sound is heard, dies away, is heard again; all that is known in consciousness is the repeated entrance of the sound and the memory of the fact that it had been lost out of view a moment before.

The next most striking phenomenon was the remoteness of objects in their relation to myself. After the phenomenon had begun to be noticeable I wrote down on the spot the condition I found myself in. The words are: "Events seem more distant in feeling of subjectivity—events happened seem to have happened in time remotely related to the observer—apparently the time seems quite remote—yet after all it is not really longer than the usual time. Events in space are less personal, yet not further away. My feet on a chcir in front do not seem so close to me but my legs are not longer." I could estimate a period of five minutes quite correctly; I could touch objects without any noticeable error of estimation. Yet events of five minutes ago belonged to the past and objects on the table beside me seemed scarcely to be there for me to reach them. During the following day I several times noticed that a minute after seeing a place or an object, the event might as well have occurred on the previous day.

All these phenomena, in a minor degree, I have frequently observed when depressed by dull weather or by fatigue. On those occasions and under the influence of hemp there seems to be a partial loss of power of volition in general. This, I think, gives the key note to the phenomena noticed. Holding a sensation steadily under attention requires an effort, in fact, even when the sensation is strictly attended to, it unquestionably undergoes continual fluctuation of conscious intensity. Attention, even in its simplest form, the so-called involuntary attention, includes an element of subjective reaction to the sensation; it is a phenomenon of will in its simplest stage. This decrease of will power, or reacting power, would render the fluctuations of attention greater. The remoteness in time seems to depend on the weakness of attention. As already stated, the actual time does not seem longer; events are as correctly localized in time as in space. But whenever a memory of a past event, even though it occurred only a minute ago, is called up, it seems to belong to the distant past. Memories are remoter the fainter they are. The calling up of a memory requires an act of voluntary or involuntary attention. Any weakness of will would tend to produce a weaker—and thus remoter—memory. Since we know that memories grow fainter as the time elapsed is longer, an over-estimation of the past is natural.

The remoteness of objects in space is due to a conscious or unconscious estimate of the effort necessary to reach them. When the effort is more difficult, as with fatigue, hemp, etc., its amount will be over-estimated; objects will appear remoter than otherwise although our previous knowledge of their space-relations prevents any distortion of space itself.

The drug finally produced faint illusions, chiefly ceilings decorated with colored designs, and finally sleep. It is noteworthy that the progress of the drug took place in stages, there being a continual fluctuation between loss and recovery of power.

The conclusion seems to be that among the earlier phenomena produced by *Cannabis Indica* the most prominent is a diminution of the power of subjective reaction in sensations, or a decrease of primitive volition. This leads to an incapacity for both involuntary and voluntary attention whereby sensations are dropped out of consciousness for intervals of time. The loss of power of attention also affects the memories, making them much weaker; this leads to an over-estimation of the remoteness of past events although time is not directly over-estimated. The decrease of volitional power leads to an over estimation of the remoteness of objects from the person, since to reach them would require more effort than usual.

Finally, let me suggest some lines of experiment to be performed before and during the influence of hemp: 1st. the rate of voluntary tapping to test the effect on simple voluntary movements; 2nd. graphic records of the time of fluctuation of some sound, to determine the periods of fluctuation of attention; 3rd. estimation and record of one second of time; 4th. experiments on will-time. Owing to disagreeable after-effects of the drug on my organism I shall probably be precluded, for some time, from carrying out these experiments myself.

LETTERS TO THE EDITOR.

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

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

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

Science in the Schools.—A Reply.

Science of Sept. 29 contains an article by Professor Chapin discrediting the value of scientific instruction below the High School, and questioning the wisdom of placing such instruction in the grammar and primary grades. Several evident misconceptions in the mind of the writer both as to the nature and value of such science work impel me to reply. The wisdom of introducing and maintaining in the grades systematic training in the sciences, is believed to be made apparent by the following nearly axiomatic statements.

1st. The prime function of the school is to *educate* the individual in order that he may be of the greatest service to society in general and himself in particular.

2. A person has acquired intellectual culture—is *educated*—only to the extent that he has learned to use *all* his mental faculties to the best possible advantage, and has incidentally obtained some knowledge. To quote from most worthy authority, these faculties should be "like a team, which is *quick, strong* and *in harness.*"

3rd, Real science teaching supplies a training absolutely necessary for complete mental development, vital, in many cases, to the highest success of the individual.

4th. The particular training cannot be said to have been obtained generally under the old regime, as is well known by those who have had to deal with the graduate of our grammar grade.

As a teacher of the natural sciences, who has been trying for some time to determine *where, what* and *how much* such instruction should be placed in the grades below the High School, allow me to present briefly the results to be accomplished and make some suggestions as to how a place may be made for it even in our already over-crowded courses. Thorough scientific training, such as may be given by skilled teachers, will yield the following results:

1. *The cultivation of the powers of observation; the ability to obtain knowledge first hand through the agency of the senses.* This, of itself, brings no special mental vigor, for savages are known with sight and smell developed to such an extent as to rival that of the beasts about them, and yet who cannot appreciate number beyond the fingers of one hand. Combine such power, however, with a mind well trained in other directions and you may expect wonders in the trades and professions.

2. *The preparation of written records of these observations in clear, accurate, concise language, supplemented with equally clear* and *accurate drawings.* In this way the quality and value of the observations are to be tested, the facts fixed in the memory and there is supplied a rigid, most valuable and so sadly needed exercise in the vernacular.

3. *Logical reasoning upon these observations, the deduction of truth* and *generalization.* Logical habits of thought and the ability to generalize, of course, characterize the mind of the scholar, but by judicious training they may be developed, and even earlier in life than is generally supposed by education. If oue observes closely a bright active child of three or four years of age, he will be found to be continually forming judgments and generalizing. His conclusions are generally wrong because based upon a too limited number of observations. I have seen an *eleven weeks'* old iufant make a series of observations, form three identical judgments and then arrive at a general conclusion. There has been so little in our elementary school courses to develop or in any way to call into action the reasoning faculties, that this characteristic is soon lost sight of. Arithmetic, when properly taught, gives a valuable training in deductive reasoning. but the tendency of even our best texts has been to disregard the discipline and render the processes largely mechanical.

4. *The acquisition of useful knowledge.* The amount of useful information to be obtained from a series of properly graded science lessons, extending over a period of eight or ten years, is by no means inconsiderable. A good elementary knowledge may be obtained of botany, zoölogy, geology, physiology, physics and chemistry; enough for general culture and to enable the pupil to read with some intelligence along any or all of these lines in case he must now leave school. A child of my acquaintance, before he had reached the legal school age, could point out the parts of a flower, locate the principal organs and bones of his body and could identify a dozen and a half of animals by their physical properties.

5. *A love of Nature.* Associated with a teacher enthusiastic in the study of Nature and natural phenomena, thoroughly imbued with a love of truth for its own sake, the pupil can scarcely fail to catch something of the teacher's spirit. A true appreciation, however, of the works of the Creator can come only when he, by means of scalpel and microscope, if need be, is given an insight into their *real* beauty, structure, harmony and wonderful diversity. In this most important respect they differ from the works of man,—the best of which must be viewed from this or that standpoint, in certain lights only or from a distance squinted at through a tin funnel. Nature may thus be given a new charm for the pupil, his walks to and from school, or into the country yield an added pleasure, his happiness has been multiplied by a factor, the value of which depends upon his teacher and himself, but which is always greater than unity. He now really

> "Finds tongues in trees, books in running brooks,
> Sermons in stones, and good in everything."

His mind engrossed in the contemplation of a plant, animal or pebble, or absorbed in the interpretation of some natural phenomenon, has little time for evil thoughts. He must grow wiser, better and more loving. I cannot agree with Professor Chapin that the collection of animals and plants and, if necessary, the "picking them to pieces" lessens in any way, the pupils' "regard for God's creatures." On the other hand, in this way is such regard most certainly developed and maintained, a bird in the hand being worth a *dozen* in the bush. This does not imply that the pupil is to *continue* his killing and picking to pieces, and my experience with boys is that those who have acquired the most intimate insight into the wonders of Nature hesitate longest before *wantonly* destroying any of her forms.

Instruction in the so-called "Natural Sciences" is peculiarly adapted to the lower grades. 1. The materials are, on every hand, directly associated with the pupils at all times, and constantly appealing to their intelligence. 2. These sciences are, for the most part, "observational," and their study admirably adapts itself to the natural development of the child's mental faculties. 3. The child takes a more active interest in everything that has been produced by Nature—that has "growed"—and especially is this true if the object is "*alive.*" Were it not for this the *scientific* study of jack-knives or hairpins would serve a good purpose. 4. The collection of material takes the pupil into the open air. 5. The supplies cost nothing beyond a few lungs-full of this luxury, a brisk walk, an increased circulation and a healthy cheek-glow. 6. The information obtained contributes to the general culture of the pupil, is, at times, vital to his happiness and physical well-being, and has the advantage, *to him,* of having, in certain cases, a money-value aspect. In view of all that has been said, I would place this instruction not only in the primary grades, but into the kindergarten as well—I would go a step further and have the child make a feeble beginning while he is still tottering about his mother's knees. He is then, in reality, more of a scientist than he is given credit for. With the true inductive spirit of an original investigator he is discovering, with his spoon and ball, the laws of energy and the properties of matter—a veritable "Newton in petticoats."

Wide-awake teachers and superintendents experience no insurmountable obstacle to introducing some instruction of this nature into the already crowded curriculum. The time devoted to other subjects may be shortened by a few minutes each and fifteen to thirty minutes secured daily. It is confidently believed that the time lost in each subject will be more than made up to it through the discipline secured and the refreshed minds and spirits.

If it is not deemed wise to have daily lessons weekly exercises of thirty minutes each may be given Friday afternoons, some of the lighter subjects, as spelling, reading or penmanship giving way. This exercise may take the place each week of some one of the regular studies, changing from one to another, so that the loss to any one is imperceptible. Were I in a school where none of these methods could be put into practice, I would make the work optional and give it after school hours.

It is, perhaps, needless to remark that the entire course from kindergarten to high school should be unified and systematized. The observational sciences should come first and the experimental later. A portion only of each year should be devoted to any one science; zoölogy, botany and geology in the spring and fall, and physiology, chemistry and physics in the winter.

Whether or not our educational systems have made the failure ascribed to them by President Elliot, it is certain that much is to be placed to the debit side of the account, and it is gratifying to teachers of science to learn that the discipline he prescribes as a remedy, as well as much in addition, is fully covered by genuine science work. Pupils come from our schools with the verbal memory well trained and, if the school is of the best, some literary culture, but the majority are perfect imbeciles, as far as the use of their perceptive and reasoning faculties is concerned. In this particular they have gained but little, if any, over their childhood, while with an acquired amount of superstition, they fall a prey to imposters, quacks and sharps. A single one of the Detroit dailies carries from five to eight paid advertisements of clairvoyants who are presumably making a living upon the gullible people of that enlightened community. Some three weeks ago one of them, advertising to cure a long list of diseases, including all of a "strange and mysterious nature," was called upon to treat a boy supposed to be *bewitched.* Think of it! In this enlightened age, in a state which boasts of its educational system and almost within shouting distance of its great university. Upon the stand she admitted having no knowledge of medicine, and it required the coroner's jury to determine that she is a "fraud."

Give science a place in the grades along with the so-called "practical studies" and then shall we soon have a "survival of the fittest." W. H. SHERZER.

Michigan State Normal School, Ypsilanti, Oct. 17, 1893.

BOOK-REVIEWS.

Text-book of Geology. By SIR ARCHIBALD GIEKIE. Third edition, revised and enlarged. London and New York. Macmillan & Co. 1893. pp. xvi, 1147, figs. 471, frontispiece.

THE promised revision of this well-known work has just appeared in this country. The first edition came out in 1882 and the second in 1885. As stated in the preface, the book has been increased by about 150 pages. The value of the work has been further increased by the insertion of copious references to important memoirs and papers.

The arrangement of the matter treated is that followed in previous editions, the natural relations of the several subjects of which might well have been brought out by an introductory discussion of the philosophical classification of geological phenomena proposed by Gilbert. The sections on the characters of rocks have been largely revised and new and improved illustrations introduced. The reproduced photographs of porphyritic and orbicular structure on pp. 99 and 101 constitute a departure in text-book illustration which ought to be adhered to in the hand-book of the future. In the matter of terminology, one notes with satisfaction the author's precision in the use of such terms as "slate," for instance, as characteristic of argillaceous rocks possessing slaty cleavage. The microscopic structure of the clastic rocks is fully up to date. The igneous rocks are treated in the light of the studies of the most advanced petrographers. Prof. Geikie, we think, rightly adheres to a simple classification of the igneous rocks into an acidic, intermediate and basic series, since he deems it inexpedient to divide them as does Rosenbusch into an ancient and modern series. Zirkel's error in mistaking plagioclase for sanidine in the andesites of the 40th Parallel Survey, made known by the work of Hague and Iddings, is noted.

Prof. Geikie thinks the geological evidence demands "an amount of time not far short of the hundred millions of years originally granted by Lord Kelvin," and he has evidently read Mr. King's admirable paper published this year (see p. 60).

In the section on Denudation, the competency of meteoric agencies to reduce lands toward a base-level is ably discussed, but the American student who has followed the advanced studies in geographic evolution published by Davis and others within the past five years will be somewhat disappointed in the retention of the phrase "plain of marine denudation" for the term "peneplain" adopted by G. M. Dawson and other writers on the great base-level of erosion in North America. Prof. Geikie maintains that the finishing touches in these table-lands of erosion are given by the horizontal planing action of the sea.

The action of bacteria in producing decay and soils is not mentioned, but this recently discovered geological agent is scarcely missed in the interesting discussion of the geological action of plants and animals. The work accomplished by cryptogamous plants is carefully reviewed and fully presented. In the discussion of coral-reefs, the views of Darwin, Murray and A. Agassiz are thoroughly presented. Prof. Geikie completes his review of the subject with the statement "that the wide-spread oceanic subsidence demanded by Darwin's theory cannot be demonstrated by coral-reefs must now, I think, be conceded."

The concise use of terms which characterizes the larger part of the work is further illustrated in the case of "laccolite" proposed by Gilbert for igneous intrusions which "have spread out laterally and pushed up the overlying strata into a dome-shaped elevation." The laccolites are thus contrasted with the simple "intrusive sheets" or "sills" which have the appearance of interbedded masses. This last term for the first time appears as a convenient designation for the numerous thin, interbedded rocks which are sometimes erroneously called laccolites. Prof. Geikie also carefully adheres to the generally accepted use of the term "*monocline*" as used by the geologists of our western surveys. The part dealing with metamorphism ought to be read by every student of geology. The section on Regional Metamorphism has been much expanded so as to embrace the advances recently made in this important branch of geological science. It is clearly pointed out that igneous rocks as well as clastic beds have been altered into gneisses and schists; and the effects of great pressure are carefully discriminated.

The chart of geological periods naturally differs in its main divisions from the plan recently proposed by the U. S. Geological Survey. The pre-Cambrian, including the Algonkian and the Fundamental complex, or all that has up to within a few years been called Archæn, is placed under the head of Primary or Palæozoic, a position which is still an undecided matter at least in this country. It seems clear that the Algonkian as now constituted is Palæzoic, as Dana has urged; but the "Fundamental complex" may yet be proved Archæn in the sense in which the word was originally intended. The Quebec group has been dropped, as it should be. The North American Pleistocene glacial periods are described under the head of Champlain, as in the previous edition, a summary which seems strange to the student of glacial geology in this country.

The book on Stratigraphic Geology is particularly enriched by abstracts setting forth the recent accessions to our knowledge of the ancient and usually metamorphic rocks. The work of Van Hise and his collaborators and Walcott on the Algonkian and Cambrian has been freely incorporated in the present work. The author does not enter into the discussion as to the extent or importance of the supposed glacial period based upon the Baccus Marsh, Dwyka and Talchir conglomerates. The Dwyka (Africa) beds are, it is suggested in accordance with the work of a recent observer, of volcanic origin. Although Professor Geikie has made the freest use of the correlation papers recently published by the U. S. Geological Survey, it is evident that he was debarred from reference to the admirable résumés of Messrs. Clark and Dall on the tertiary and of Dr. White on the Cretaceous, since these are not referred to.

In the description of glacial deposits one misses the distinction made in this country between kames proper and eskers, as proposed by Chamberlin. No explanation of eskers is given, though American and Scandinavian geologists are generally agreed that they owe their peculiar shape to deposition within the ice-sheet, explanations varying only in regard to the place in the ice where the stream originally flowed. The question of succession of glacial epochs in North America is hardly up to date, but one could scarcely expect a writer not familiar with the ground to hazard a succinct statement in view of the present diversity of opinion in America. The evidence advanced on p. 1051 as a means of dividing the glacial period, pertains to moraines, both of which it has for some time been held are far more recent than the most ancient drift accepted by any geologists who have studied the deposits. The pit-falls into which the most careful correlators are apt to fall find an illustration in the implied magnitude of the glacial deposits on the land skirting the New England Coast. It is hardly known even in America that in the highest part of Martha's Vineyard, for instance, Cretaceous clays may be pulled up in the grass-roots, since the bulk of the larger of these islands consists of upturned Cretaceous and Tertiary strata.

In the list of authors quoted the reader gains a ready measure of the influence of American geologists on the thought of their fellow-workers abroad. The familiar names of more than a score of American geologists need not be mentioned here. The index has been much extended and includes several scientific terms not found in the last edition. The whole shows the good, readable press-work of a well known publishing house.

While the American student will find the recently published correlations papers of the U. S. Geological Survey the most valuable hand-book for this country, this great work of Prof. Geikie will be indispensable both to the teacher and the professional geologist. Not the least important part of the book consists in the bibliographic references without which a text-book can now hardly be recommended to the advanced student. It may be objected to the work that is encyclopedic rather than didactic, but in so far it is a faithful exponent of the concensus of opinion of a host of geological workers.

J. B. W.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

For Exchange.—Books and pamphlets on geology, ornithology, conchology, and entomology. State what line and I will send list. I want Odonota from any locality, and literature on this group. M. J. Elrod, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—The remains of three individuals, one young and two adult, of Elephas Americanus found in Jasper Co., Mo. The remains comprise most of the skeletons, and comparatively little restoration would have to be done. The bones are in a good state of preservation and have not been worked out. For terms and further information address E. O. Hovey, 239 Center St., New Haven, Conn.

Wants.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

FOR SALE.—Volumes V. and VI. of the "Explorations for a Railroad Route from the Mississippi River to the Pacific," 1857, half calf, in good condition; a large number of colored and uncolored plates of Mammals, Birds, Fish, etc., etc. On receipt of $7.00 will send to any ordinary point in the U. S., express paid. These volumes are now rare. Address Dr. Shufeldt, Takoma Park, Dist. of Columbia.

A YOUNG woman who has been an assistant for a literary and scientific man desires a similar position. Is an experienced and accurate stenographer and typewriter, thoroughly educated, and sufficiently familiar with literary work to write, independent of dictation. Has some knowledge of the Spanish language. Will go to any part of the United States. Address, Box 147, Ravenna, Ohio.

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QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, NOVEMBER 3, 1893.

COSTA RICA AT THE EXPOSITION.

BY FREDERICK STARR, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

THE visitor in the Anthropological Building experienced a real delight and relief in coming upon the exhibit from Costa Rica. The displays in its neighborhood (from Mexico, Brazil and Paraguay) contained much of interest, but were inartistic and lacking in unity. The Costa Rica exhibit was in some ways a model.

The pavilion itself is quaint and attractive. A space of perhaps fifty feet by thirty is enclosed by a rather high board wall. Two doorways, facing each other, are in the middle of the longer sides. These doorways reproduce ancient flat-topped stone arches, decorated at their top corners with coarsely carved heads and squat figures. Large oil paintings hang on the external walls, one on each side of each doorway. They are set in wide gilded frames which are decorated with fret patterns copied from the stone ruins of Central America at the sides, while the upper border consists of enlargements copied from the grotesque bird and other figurines of gold which are found in the ancient graves. The pictures represent: (a) an Indian hut from Talamanca, (b) a view on the Uren River, (c) a chief's summer hut, in the Suerre Valley, dating back to 1544, (d) an Indian hut in San Bernardo, Sipurio, Uren Valley.

Entering the pavilion the visitor finds at the middle of the narrower sides gilded medalions, one of Vasquez de Coronado, the other of Isabel la Catolica. Each is the centre of a trophy composed of spears, bows, drums, nettings and fabrics of the modern Indians of Costa Rica. Upright frames, copper bronzed, with ornamentation derived from the old figurines contain full length and about life-size paintings of (a) a Talamanca Indian, with necklace of teeth, red ribbon hair-band, staff and breech-clout; (b) a Talamanca Indian woman with a little boy standing by her: the child is naked, while the woman wears a narrow red ribbon in her hair, a necklace of narrow strands, and a skirt cloth about her waist; (c) Indian of Guatuso, seated on a stone with hands on knees and wearing a breech-clout; (d) an Indian woman of Guatuso with waist cloth and cap. On the broader walls are also pictures, in horizontal frames, green bronzed and with ornamental patterns of frets and figurines. These pictures are in pairs, are on each side of each doorway and represent old Guetar graves, walled up with either rough rounded stones or narrow slabs. The details of construction are shown and the methods of archæological exploration. All of these oil paintings are by one artist—S. Llorente. The pavilion containing four handsome upright cases of oak, with plate glass doors, constructed for display on all four sides, and with a crimson or maroon background. In these and in flat cases about the sides of the pavilion is a choice series of archæological specimens. Objects too large for the cases are arranged on individual supports in various parts of the room.

The ancient art of Costa Rica is very near, if not identical, to that of Chiriqui, so well described by Mr. Holmes. In the series here shown there are many *metates* or stones on which corn is ground. Some of these appear to be quite recent and are no doubt used by the present Indians. They are made from a grayish, porous, volcanic rock, and usually present a rounded cornered, slightly basined, squarish upper surface, on which the grinding is done, supported by queer animal carvings. Stools of similar material are numerous. These present fairly flat wind tops, supported by a carved openwork base, in geometrical patterns or representing animals; sometimes a band about the upper edge is carved with a line of faces or grotesque heads. Very common are human heads, carved in the volcanic material, displaying considerable variety in feature, and some with tattooed patterns on the cheeks, or with headdresses. Less common, apparently, are the heads of mammalia, some of them admirably done. Full length human figures, about a foot in length, representing both sexes, the sexual organs being, at times, strongly marked, are not uncommon. These are commonly in the same position, the hands stiffly clasped upon the waist, the arms to the elbows closely against the sides. Yet more numerous are the quaint little figures, some six to ten inches high, squatting, with knees drawn up in front and the elbows resting on these. In some cases both hands are held to the chin or mouth; in others one hand is at the mouth and the other is on the knee. In almost, if not quite, all of these the head is exaggeratedly long and frequently bears a headdress or curious hair arrangement. Many hold a somewhat long cylindrical or barrel-shaped object to the mouth, with one or both hands. This object resembles somewhat an ear of corn, but the Costa Rica archæologists, I believe, consider it a cigar. In the flat cases is a large series of celts, or polished stone blades, mostly of the usual Antillean or Central American type. Many more special forms of stone objects might be mentioned, but we must pass to the fine series of pottery.

Here there are vases and jars of many forms in colors, commonly red or brown. Some are painted, others decorated with grotesque animal or human devices in relief; others quite plain. Many of the jars are tripod supported, and the legs are frequently hollow and with a little rattling ball of clay inside. Terra cotta whistles are plentiful—some simple, some in bird forms, some human figurines. Among these last are a few elaborate female figures, several inches high, with a considerable number of apertures to give a range of notes. Some plain ones are distinctly *ocarinas*. Rare, apparently, are the terra cotta rattles, copied after gourd rattles, and body and handle made in one piece. Very numerous are the little, flat, round, spoon-shaped censers, with handles wonderfully varied in ornamentation. Scores of pottery rings, like napkin rings, contracted usually about a middle zone, are plain, incised, or decorated with reliefs. In all the pottery, and of course we have not mentioned all the variety, there is similarity or identity with the Chiriqui work described by Mr. Holmes.

We find the same identity in the gold figurines, a fair series of which are displayed in two little wall frames. There are quaint and grotesque figures of birds, beasts, frogs and nondescripts. With these are a few of the little bronze bells (something like sleigh bells) and some thin, rather broad disks of gold, three of them with designs worked out upon them.

It must be plain to the readers that the little republic has done herself credit. The exhibit was at Madrid last year, and there an excellent catalog in Spanish was printed. The collection is displayed by the *Museo Nacional de Costa Rica.* Space does not permit tracing the history of this young institution, but we must say that the credit of the present exposition on its behalf is in large part due to three gentlemen: J. Arellano, M. M. de Peralta and A. Alfaro.

NOTES AND NEWS.

The Contemporary Publishing Co. have a book of value to young mothers in "Nursery Problems," edited by Dr. Leroy M. Yale, medical editor of *Babyhood*.

—Estes & Lauriat have just ready for the holiday season a new volume of the Zigzag Series, "Zigzag Journeys on the Mediterranean," in which the author takes his readers to the classic cities along the shores of the historic sea, where they listen to many a folk-story and Oriental legend.

—Considerable interest is felt in the announcement that the first number of the *Psychological Review* will be published early in 1894. It will contribute to the advancement of psychology by printing original research, constructive and critical articles, and reviews. The growth of scientific psychology in America during the past few years has been rapid, and it is felt that a Review is needed which will represent this forward movement with equal regard to all branches and to all universities and contributors. The Review will be edited by Professor J. Mark Baldwin (Princeton) and Professor J. McKeen Cattell (Columbia), with the co-operation of Professor A. Binet (Paris), Professor John Dewey (Michigan), Professor H. H. Donaldson (Chicago), Professor G. S. Fullerton (Pennsylvania), Professor William James (Harvard), Professor G. T. Ladd (Yale), and Professor Hugo Muensterberg (Harvard). The *Psychological Review* will be published by Messrs. Macmillan & Co., of New York and London, and all matter pertaining to its business management should be sent to the publishers; communications regarding contributions to the editors direct. Subscriptions should be sent to the publishers. Price of single number, 75 cents. Subscription, $4.00 a year (the volume contains about 600 pages).

—Swan Sonnenschein & Co. announce a new book for immediate publication, under the title of "Modern Mystics and Modern Magic," by Arthur Lillie, containing a full biography of tha Rev. W. Stainton Moses, together with sketches of Swedenborg, Boehme, Mme. Guyon, the Illuminati, the Kabbalists, the Theosophists, the French Spiritists, the socieiy of Psychical Research, etc.

—The translation of the Slavonic versions of the Book of Enoch by Mr. Morfill, announced for early publication by the Clarendon Press, will be delayed in its appearance, owing to the discovery of fresh Slavonic mss. embodying a purer text and containing additional material. These mss. have been found by Prof. Sokolov, of Moscow, who has generously placed them at the service of Mr. Morfill.

—Messes D. Appleton & Co. announce the Anthropological Series edited by Prof. Frederick Starr, of the University of Chicago. The books in this series will treat of ethnology, prehistoric archæology, ethnography, etc., and the purpose is to make the newest of all the sciences—anthropology—better known to intelligent readers who are not specialists and have no desire to be, although the series will be one which no special student can afford to ignore. While these books will be of general interest, they will in every case be written by authorities, and scientific accuracy will not be sacrificed to popularity. The first book in this series will be Woman's place in Primitive Culture, by Prof. O. T. Mason, of the Smithsonian Institution, wherein the author traces the division of labor between man and woman, which began with the invention of fire making—a most suggestive subject, and one of immediate interest. Other volumes will follow shortly.

—"King's Handbook of New York City," which was first published by Moses King, of Boston, about a year ago, has now appeared in a second edition and forms a handsome volume of a thousand pages. It opens with a brief sketch of the history of the city; and then goes on to speak of the harbor and the streets, the railways and the hotels, the modes of living among the various classes of the people, the charitable institutions and all other phases of New York life that a visitor would wish to know about. Several chapters ear given to the government of the city, including the police and fire departments, and also to clubs, theatres and other centres of social life and amusement. Nor are the intellectual and moral interests of the people by any means neglected; but due notice is taken of the churches, schools, colleges and literary and scientific societies, and of the libraries. But, as New York is the commercial metropolis of the continent, a large space is necessarily devoted to the vast business interests that centre there; the banks, insurance business, manufactures, wholesale and retail trade and all other branches of industry being described as fully as most readers will desire. This second edition of the book has been carefully revised under the direction of Mr. King himself with the help of many assistants, and considerable new matter has been added. The illustrations, as stated in the preface, are over a thousand in number, of which three hundred first appear in this edition. The book is well printed on excellent paper, and contains an elaborate presentation of New York life and the varied interests of its people.

—The Appletons have issued a pamphlet entitled "The Philosophy of History," by Rev. E. P. Powell, the contents of which were originally a lecture before the Brooklyn Ethical Association. The author is firmly convinced that history can be treated in a scientific manner as an orderly sequence of causes; and he accordingly lays special stress on general tendencies and on the uniformities observable in the development of different nations, while he is rather inclined to underestimate the influence of great men. His principal aim in this work, however, is to trace the successive stages in the development of society from the primitive family to the state, the church and the industrial organization of the present day. Of course only the barest outlines of the subject are presented; but those who are not already familiar with the evolutionary philosophy of history will find here an epitome of it from one of its ardent disciples. Mr. Powell is thoroughly optimistic, maintaining not only that humanity has always progressed in the past, but also that it will continue to progress in the future. In the appendix are given the replies and criticisms of two other men, who were present when the lecture was delivered; and their remarks are worthy of attention in connection with the author's own. We are not so sanguine as Mr. Powell is that the course of history will soon be explained, but we think it ought to be treated in a philosophic spirit, and so we are glad to have the subject discussed.

—The Open Court Publishing Company have issued, in pamphlet form, the address on "Our Need of Philosophy," delivered by Dr. Paul Carus at the World's Congress of Philosophy, in Chicago, in August last. It opens with a few remarks on the importance of philosophy to mankind in general and on the conditions on which its development depends; and then, after a brief sketch of the leading characteristics of German, French and English philosophy, dwells on the special need of philosophy to-day for the guidance of American life. Dr. Carus pleads not only for a deeper study of philosophical problems, but also for the teaching of philosophic truth to the masses of the people, and justly remarks that "the United States of America are so constituted that we have but one choice left us: we must educate the masses, or go to the wall." He dwells on the great opportunity that we Americans have before us, but reminds us that "an opportunity can be lost as well as improved." The address, though short, is very good, and will interest everyone who cares for philosophy.

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

ENGINEERING LABORATORIES.

BY R. C. CARPENTER, ITHACA, N. Y.

IT IS the object of the present article to point out how an Engineering Laboratory can be equipped for a comparatively small expenditure.

In discussing the subject I shall confine myself purely to the educational features and will not consider the laboratory as a place for investigation or solution of advanced engineering problems. I may also be permitted to say that there are few colleges in America, perhaps in the whole world, in which students, as a rule, gain sufficient culture, or indeed have sufficient time to undertake the work of investigation of engineering problems, in an undergraduate course. It is only in those courses where a great number of graduates are to be found that problems of research have any legitimate home.

The undergraduate laboratory should be equipped so as to demonstrate in a practical and convincing way the principal laws or facts that the student must master in order to finish his course. Its course of instruction should be such as to require systematic work of the student, teach him how to observe, how to use apparatus, how to deduce conclusions from his mass of data and finally how to make a neat and systematic report of his work.

Having that object in view, the best methods or means of execution remain to be sought. In this respect two courses will be open, one, which at first may seem simpler and better, consists in laying out on a single schedule all the experiments that can possibly be performed by the students, with the apparatus at command. Students are assigned to these various experiments as they report for duty.

The other consists of a course in which are put the more important experiments; every student to take in turn each experiment. In laying out a system of such work it will be necessary to have a series of independent experiments for each term, so that the order in which they are taken is immaterial.

From personal experience I am positive that the latter is the only way to successfully conduct an engineering laboratory, unless you are possessed of an almost infinite equipment, an unlimited patience, and an entire disregard of order, and even then a great number of students, working in as many lines, would be certain to cause vexation, delay or trouble in some direction. Besides all this the amount accomplished by an individual student is generally small, since a large part of his time has to be devoted to preparation, looking up apparatus, and in finding people willing to lend.

By arranging for a certain definite number of experiments each day, which are sufficient for all the students reporting that day, and repeating these day by day until each student has performed each experiment, the conditions are not only more favorable for systematic orderly work, but a minimum amount of apparatus will be required and more efficient and better directed instruction can be given. In such a case the apparatus is easily kept where needed and in good order, and the student can devote the required time purely to the experimental work. I will not deny that the work of preparation and of looking up apparatus is of benefit to the student, but it is not experimental work and should have a place in some other part of the curriculum.

I hope I may be excused for devoting so much time to this discussion, but I feel that it is an important matter, and vital to the subject of the article. In the physical or chemical laboratory I believe that the best results are obtained by the first system, since working apparatus is portable, experiments quickly arranged and the results more definite and constant in character, and the same system is likely to be applied to engineering, thought not being given to the facts, that engineering constants are seldom more than coefficients, and the value is affected by the method used in testing. In many engineering experiments the method is of equal or greater importance than the results.

For the reasons just stated I would advise a limited number of experiments each term and require each student to take the course as laid out. I am positive that the better instruction obtained will more than offset any loss due to the want of selection.

The nature of these experiments must depend upon the apparatus, but I will, however, refer to a course which might be pursued in case the equipment was extremely small. Suppose, first, the course to be in civil engineering, in which case the laboratory work will relate principally to strength of materials and hydraulics, field work and astronomy, the two latter will not, however, be included in this laboratory course. The apparatus needed might be certainly as much as could be purchased, but one testing machine of 50,000 pounds capacity, arranged for testing in tension, compression and transverse, a cement testing machine, a small drop of 100 pounds falling ten feet, and a wooden beam twenty feet long and four by eight inches in dimensions, will be found to be sufficient apparatus to keep four experiments, two men at each, in operation the entire time. The cost of such apparatus will probably not exceed $1,000 and possibly might be less.

The experiments that might be performed are almost infinite in variety in the line of strength of materials, and the students could not only obtain skill but also valuable knowledge respecting the properties of materials.

Some of the most interesting experiments are performed with little or no apparatus, as, for instance, by loading a beam in different ways and studying the effect on the elastic cam produced by the load in various positions.

For hydraulics, little is needed but what can easily be made by resident mechanics, excepting tanks and weighing scales. Weir notches and hook gauges are readily made and ensure materials for an almost endless variety of experiments.

Small water motors and pumps are quite inexpensive, so that probably for $500 an equipment that will give six experiments and keep twelve men at work constantly can be had. If a student could spend six hours a week, which is about the amount required to complete a single experiment and write a complete and satisfactory report, there would be found outlined, as above, sufficient for three terms or one year's work.

For mechanical engineers the field must be broadened out so as to include the various classes of prime movers, engines, boilers, gas engines, etc.; but in this case as in the other, with a few small pieces of apparatus, and a few accurate measuring instruments, a great number of useful and valuable experiments can be performed.

For the purpose of investigation and study, a tool or machine rejected for inefficiency or wear by the owners, will often serve as good a purpose as a new machine. The results obtained often point out a line of practice which should not be followed, and this becomes an enduring lesson on the student's mind.

I have elsewhere endeavored to point out in detail methods of performing engineering experiments, and I wish to call to mind here my emphatic opinion that so far as educational results are concerned, the equipment required need not be so expensive that it cannot be furnished in any college of engineering in the country. It is, perhaps, hardly necessary to remark that a little apparatus, employed to advantage, is of more benefit than a large collection used merely to adorn a cabinet or to advertise a college. My own experience leads me to believe that no species of instruction is of as much value to the student as that in which he participates, and knowledge obtained by "feeling" it out, by proving by actual experiment, remains with one and is more readily at command than that obtained purely through the senses of sight and sound.

This leads me to place a high value on this species of instruction, but above and aside from all this is the fact that engineering is an art, founded on imperfect applications of the science of mechanics; all that we get in this line, every engineering truth, must be proved, if not originated, by the laborious processes which are first taught in an engineering laboratory; and he who would advance his profession must be skilled in all that relates to observation and investigation.

ANIMAL BIOLOGY IN HIGH SCHOOLS AND COLLEGES.

BY W. XAVIER SUDDUTH, A. M., M. D., UNIVERSITY EXTENSION LECTURER AND PROFESSOR OF EMBRYOLOGY, ETC., IN THE UNIV. OF MINNESOTA, MINNEAPOLIS, MINN.

No one, at the present day, questions the importance of animal biology in the curriculum of all well conducted high schools and colleges as well as in the better endowed universities and professional schools. The question is rather, how may this be accomplished? That there is a sad lack of competent instruction in these branches, even in schools that make it their business to educate teachers, cannot be denied.

The need is only too apparent but the laboratory method is not way the to remedy the defect in our smaller colleges and high schools, because it is beyond their financial ability to secure it.

This obstacle may, however, be overcome to a certain extent by the use of the stereopticon and lantern slides which may be had at a cost that is within the reach of any school board. The price of stereopticons has, within the past few years, been materially reduced and the quality greatly improved, so that now a good working lantern with suitable accessories for projecting photo-micrographs on the screen, for ordinary class work, may be had for a sum as low as fifty dollars. Then again the process of reproducing histological subjects has of late been so developed that they may be had from almost all dealers in school supplies at a nominal outlay. Very little has, however, been written upon this method of illustrating lectures on physiology and hygiene in our public schools and it is with this in view that I have undertaken the present article.

I have no hesitancy in saying, at the outset, that a better understanding of the histology of tissues can be imparted to a greater number of students in a given space of time by this means than can be obtained by the laboratory method. I do not desire to be understood as decrying the *practical working laboratory*. Where time and equipment are sufficient no better method can be had for studying biology in all its phases, but where either of the above essentials is lacking the lantern becomes a valuable substitute, and even where the laboratory method is employed I have found the lantern a very valuable adjunct in imparting a general knowledge of the subject. As a method of illustrating didactic lectures on histology I consider it far ahead of charts. In its use the matter of "personal equation" is reduced to the minimum, and it carries a more vivid impression of the original tissue because of the fact that it is a photograph. In the use of the lantern the educated senses are appealed to and valuable time saved that in the laboratory method is spent in learning the technique of the microscope which in after years is of little avail unless the individual continues in practical Laboratory work. If the object sought is the making of microscopists and original investigators then use the laboratory method combined with the lantern for class demonstration, but if time or equipment is a desideratum the lantern will be found to be fully adequate for good class instruction. Ten years' experience as a teacher of biology leads me to speak thus positively on this question. Trained in the best German laboratories I naturally followed their methods when I began teaching. Gradually the lantern was introduced to illustrate didactic lectures. At first use was made of the oxyhydrogen lime light for projecting actual tissues upon the screen. Many valuable specimens were lost by overheating. Various cells were introduced to prevent this, but they shut off the light to such an extent as to minimize the result desired to be obtained. I was led to substitute solar light for the lime light, but the uncertainty of the results led to its abandonment in favor of photomicrography, and now with an inexpensive oil lantern better results are obtained by this process than formerly with the most expensive stereopticons, under the most favorable conditions. I make my own photomicrographs and find it a delightful recreation. In past years I used to keep on hand an extensive cabinet of microscopic slides for reference. These have latterly been discarded for the photomicrographic negative. My custom now is to photograph all points of especial value as I am studying and file the negatives away for future use. But little time is required for the work when one has a dark room handy which is fitted up for it.

The objection has been offered to photomicrography in that it only reproduced the slides in light and shade. To overcome this objection I have invented a process by which it is possible to reproduce the original stains of the microscopic slide in the lantern positive, in double stain if necessary, and that without hand-painting as was formerly required.

In conclusion let me reiterate that by adopting the lantern and photomicrography the subject of animal biology may be successfully brought before the classes of our high schools and colleges, now debarred from its study by lack of suitable equipment.

THE SILVER QUESTION AND BIMETALISM.

BY J. JAMES COUSINS, ALLERTON PARK, CHAPEL ALLERTON,

NEAR LEEDS, ENGLAND.

I do not think any apology is needed in introducing the silver question as a scientific one, as no subject can have a deeper interest for the American scientist at the present time, than a consideration which can furnish one particle of elucidation to this most interesting and complicated question.

In order to arrive at anything like a fair solution (and that is the only one the world which is both our debtor and creditor will listen to) we must divest it of all local and national considerations, because the fact of nearly all the silver in use being the product of America, a certain amount of prejudice against American opinions and actions is engendered thereby.

We find it stated (Wealth of Nations Vol. 1,743. M'Culloch's ed.) "Every prudent man, in every period of society, after the establishment of the division of labor, must naturally have endeavoured to manage his affairs in such a manner as to have at all times by him, besides the peculiar product of his own industry, a certain quantity of some one commodity or another, such as he imagined few people would be likely to refuse in exchange for the produce of their industry."

The question is, do we find in silver such a commodity? Do our creditors all over the world exhibit a willingness to accept payment for our debts in silver? The answer is obviously "no."

In the event of our succeeding in enforcing such payment as a legal tender, it is certain that those who did so would buy upon worse terms than those who paid in gold, a metal which all the commercial world is craving for.

Now is this craving merely sentimental, or is there good ground for its existence?

One thing is certain that large and important countries one after another are abandoning the double standard, and silver is the one sacrificed, the reason for which is not far to seek.

In order to successively maintain a double standard, we must be able to fix an unfailing ratio of value between the two metals, let us see if that is possible between gold and silver.

We find that in the time of Julius Caesar the ratio of value between the two metals was 9 to 1; in the beginning of the present century 15½ to 1, and now 27½ to 1, which seems to point to an impossibility of establishing a ratio of value, it is obvious that to measure length a standard must have fixed length, to measure value it must have fixed value, attempts have been made by powerful syndicates to give an enhanced value to copper, iron, tin, cotton, corn, etc., all of which have ultimately broken down.

Suppose for a moment the government of the great commercial countries of the world were to establish a bimetallic standard and accept silver as one of them. In order to be of any value to the silver interest, silver must be a legal tender to any amount.

From its depreciating tendency it would soon become the one medium of exchange, and gold would assuredly be hoarded, which would prove most inconvenient, for in the event of your presenting say a cheque of $5000 for payment the banker, whoever he may be, would insist upon the customer taking silver because it paid him (the banker) best to do so, and it is difficult to realise the position of the customer under such circumstances, whilst the trouble and difficulty of international exchange would be greatly enhanced.

I propose in a later article to introduce the subject of an international clearing house, the relief of which to the metallic exchange can only be appreciated by those who have a thorough knowledge of the advantages of the London clearing house, where the bulk of the trade of the United Kingdom is settled for, upwards of twenty millions sterling per day, without the interchange of a single coin.

These two subjects are so interwoven that one cannot be fairly or properly considered without the other, but this article has already run out its proper length for your columns so that I dare not do more than hint at the subject of an "International Clearing House."

I may just say in conclusion that in my opinion the "letter" of Mr. Farley who was elected President of the National Board of Trade at Washington last January, and which may be read in the official report of the proceedings of that meeting, whilst it contains many valuable suggestions upon the silver question, would be found as a whole to be thoroughly unworkable.

FAITH IN THE INTEGRITY OF THE INTERSTELLAR MEDIUM.

BY DE VOLSON WOOD, HOBOKEN, N. J.

That space is not void, is conceded. That it is filled with a medium capable of transmitting light and heat is not questioned. This medium is believed to be uniform in density and elasticity, but the exact nature of its constitution is unknown. Some believe it to be molecular like gas, while others question if its structure has been correctly defined. It makes no direct impression upon the senses, and is known only through effects produced; and yet, whatever be its nature, it is known to transmit a wave of light at the rate of 86,300 miles per second, there being, as a mean value, within the spectrum, about 50,000 waves in an inch, or more than 60,000,000,000,000,000 in the distance passed over in one second. When it is considered that waves are transmitted through this medium in all conceivable directions with the same velocity, some faint conception may be had of its intense activity. The complicity of the waves is transcendent, for each shade of light has its own wave length, there being about 36,000 waves to the inch in red light, and more than 64,000 in violet, and outside the visible spectrum there are less in number in one direction and more in the other. Every self-luminuous body in the universe is imparting to this medium waves of these varying lengths all travelling with a sensibly constant velocity. When it is considered that the countless number of stars and suns, scattered promiscuously throughout limitless space, are producing such waves, radiating from each in all possible directions, it would seem that, if they did not actually destroy each other they would so interfere as to produce "confusion worse confounded" and the impressions upon the eye of an observer would be valuless. But, on the contrary, the scientist believes that this medium truly and faithfully transmits to the remotest space every wave imparted to it, preserving with the strictest integrity its individuality —except that planets and other solid bodies may destroy the waves they intercept.

A star ten or more years ago started a wave which just now, we will suppose, arrives at the earth and writes its own record on some sensitized plates, though the star may be 6,000,000,000,000 miles away. From these impressions the physicist finds—perhaps—that the star is double, although the most powerful telescope had failed to divide it, that the two revolve about each other, and he determines there probable orbit, masses and velocities. Or, perhaps he finds, as in the remarkable star of 1892, that it changes from a star to a nebula in a few months. In all this, no question is raised in regard to the integrity of the record, nor whether in its long journey any planet, snn, comet, meteorite or nebula has interfered to modify or in any way corrupt the story it was commissioned to tell. What faith! But this is little more than the shadow of an illustration; for Herschell, the astronomer, thought it probable that we can see nebulæ from which it has taken light 300 000 years to reach the earth, during which time the interstellar medium has been faithful in transmitting at the rate of more than 11,000,000 miles per minute the impulse committed to it, notwithstanding its path has been crossed and recrossed by other waves without number. Pen cannot adequately describe the transcendant properties of this wonderful medium called the "lumineferous æther" nor to highly exalt that faith which enables one to implicitly believe the truthfulness of the stories committed to him. One is led to exclaim with the Psalmist "Oh Lord! how manifold are thy works, in wisdom thou hast made them all."

CITY BIRDS OF DENVER, COLORADO.

BY HORACE G. SMITH, DENVER, COLO.

PERHAPS some of your readers would like to know something of the city birds which come about our dwellings in Denver, Colorado, and wherein they differ from the familiar species so near to the hearts of the bird lovers who live east of the Mississippi River.

To be sure, many of the Eastern species, whose geographical range is so extensive find their way, across the Great Plains, to our city at the base of the Rocky Mountains, still true to the type of their eastern friends, but for the most part the species undergo a radical change when we enter the high and arid regions of the Great Plains and become of a bleached and faded appearance which gives rise to subspecies or varieties; or, as is often the case, a new species takes the place of its eastern relative.

Among those species which we have in common, the Yellow warbler *(Dendroica aestiva)* is perhaps one of the most familiar summer residents, and its neat little nest is often built in the shade trees along our streets or in the shrubbery of some garden, and its familiar song is heard even in the heat of midday, when most birds are silent.

Scarcely less noticeable is the Kingbird or Bee Martin (*Tyrannus tyrannus*,) the Cliff swallow and the Barn swallow, whose habits are well known to most readers and may not be detailed here, though I may mention that a pair of Barn swallows has returned to the writer's barnloft for about fifteen successive years, and when unmolested has reared two broods per season. Their mode of entrance was through an open window, which they usually found shut upon their return migration in the spring, but would soon make their presence known by repeated scoldings and flutterings before the glass and would enter and take possession as soon as the window was opened. Hence I suppose it to be the same pair, though the evidence is not conclusive.

Perhaps the most conspicuous of our summer birds is Bullock's oriole, which takes the place of the Baltimore oriole of the east. This brilliant bird is a common breeder over the entire city, wherever trees are found in which to built its swaying nest, and it is not an uncommon occurrence to find several nests—which have been built in successive years—in the same tree.

I have often watched these birds in the early morning, searching for insects in the arc light globes; their method being to enter the globe for any tempting morsel and then flying to the next in line.

Speaking of the electric lights reminds me of the little House finch (*Carpodacums in frontalis*) whose song often cheers us in the winter time, when most birds are silent. It would be hard to part with this little bird, for his song is rich and pleasing. Being a resident with us, they rear their young near to our homes, usually in trees or crevices of buildings, but being progressive they have lengthened their breeding season by taking advantage of the heat furnished by the electric lights, by building their nests in the lamp shades above the lights, thus being entirely protected from the weather.

The past summer I was told by one of the trimmers that nearly every light on his beat contained one of these nests.

Among other summer residents, more or less common I may mention the Western robin, Mountain bluebird, Warbling vireo, White-rumped shrike, Lazuli bunting, Black-headed groobeak, Western chipping sparrow, Arkansas goldfinch, western meadow lark, Say's phoebe, western wood pewee, Mocking bird and western Kingbird, the latter being a cousin of the Bee martin and having all the habits of his querulous relative.

The Pine siskin (*Spinus pinus*), though considered a migrant with us, occasionally rears its young here; a pair having built their nest in an evergreen in the writer's yard. This is not so surprising when we consider that its natural summer home among the coniferous forests may be found within fifteen miles of Denver, in the mountains.

Parkman's House wren *(Troglodytes œdon parkmanii)* seems less familiar than the eastern bird, at least in the manner of its nesting, for, though not uncommon in our city in migration, it seems to retire to the thickets along our streams to build its nest; usually taking possession of some crevice or deserted woodpecker's hole.

A few winter birds remain with us but perhaps none so common or well distributed as the House finch before mentioned. The western Tree sparrow, Mountain chicadee, Long tailed chicadee, McCown's longspur, Cassin's finch, Harris's and Batchelder's woodpeckers, the Northern shrike and several varieties of Juncos or snowbirds, though the Desert horned lark (*Otocoris a. arenicola*) is the familiar "snowbird" of the region and is often seen in numbers in the outside streets, especially when snow is on the ground.

At other times it is not often noticed though it may be present, for its plumage harmonizes well with its surroundings. Besides these we have an occasional visit from the snowflakes, Red polls and some others.

I make no mention of the host of migrants, which fill our city during the migrations, including rare and curious species of warblers, sparrows, thrushes, flycatchers etc., nor of other summer residents of the region, whose summer haunts are found in woodlands or upon the plains, for this is essentially a paper upon "city" birds. These may receive our attention at some future time.

OVERHEAD SOUNDS IN THE VICINITY OF YELLOWSTONE LAKE.

BY EDWIN LINTON, WASHINGTON, PA.

WHILE engaged in making certain investigations for the United States Fish Commission in the summer of 1890 my attention was called to an interesting phenomenon in the vicinity of Yellowstone Lake, of which I am pleasantly reminded by the following brief but vivid description in a recent report by Prof. S. A. Forbes.

Under his description of Shohone Lake, Professor Forbes, in a foot note, thus alludes to this phenomenon:

"Here we first heard, while out on the lake in the bright still morning, the mysterious aërial sound for which this region is noted. It put me in mind of the vibrating clang of a harp lightly and rapidly touched high up above the tree tops, or the sound of many telegraph wires swinging regularly and rapidly in the wind, or, more rarely, of faintly heard voices answering each other overhead. It begins softly in the remote distance, draws rapidly near with louder and louder throbs of sound, and dies away in the opposite distance; or it may seem to wander irregularly about, the whole passage lasting from a few seconds to half a minute or more. We heard it repeatedly and very distinctly here and at Yellowstone Lake, most frequent-quently at the latter place. It is usually noticed on still bright mornings not long after sunrise, and it is louder at this time of day; but I heard it clearly, though faintly, once at noon when a stiff breeze was blowing. No scientific explanation of this really bewitching phenomenon has ever been published, although it has been several times referred to by travellers, who have ventured various crude guesses at its cause, varying from that commonest catch-all of the ignorant, "electricity," to the whistling of the wings of ducks and the noise of the "steamboat geyser." It seems to me to belong to the class of aërial echoes, but even on that supposition I cannot account for the origin of the sound."

(*A Preliminary Report on the Aquatic Invertebrate Fauna of the Yellowstone National Park, etc. Bulletin of the United States Fish Commission for 1891, p. 215. Published April 29, 1893*).

In a paper which was read before the Academy of Science and Art of Pittsburg, Pa., March 18, 1892, entitled "Mount Sheridan and the Continental Divide," I recorded my recollections of this phenomenon and reproduce them here with no alteration. Although the style is, perhaps, somewhat lacking in seriousness, the descriptions were made from notes taken at the time and written out while the memory of the facts was still fresh. Indeed, even now, after a lapse of three years, I have a very distinct recollection of the sound, vivid enough at least to teach me how imperfect my description of it is. Words describe an echo very inadequately when one is in ignorance of the original sound, and especially so when he is in doubt as to whether the sound is the echo of a noise or the noise itself.

Following is the account of these overhead noises given in the paper alluded to above and published soon after by the academy:

Overhead Noises.—The last topic which I shall discuss in this somewhat desultory paper, is what I shall call overhead voices.

Lest I be thought to be indulging in some ill-advised or disordered fancy I shall first quote from Hayden's *Report for* 1872, *on Montana, Idaho, Wyoming, and Utah.* Mr. F. H. Bradley, p. 234, in that part of his narrative which relates their visit to Yellowstone Lake, says: "While getting breakfast. [This was near the outlet of the lake] we heard every few moments a curious sound, between a whistle and a hoarse whine, whose locality and character we could not at first determine, though we were inclined to refer it to water-fowl on the other side of the lake. As the sun got higher the sound increased in force, and it now became evident that gusts of wind were passing through the air above us, though the pines did not as yet indicate the least motion in the lower atmosphere. We started before the almost daily western winds, of which these gusts were evidently the foreruners, had begun to ruffle the lake."

With this warrant I shall proceed to decribe as well as I can my impressions of these overhead noises, which appear to belong exclusively to the lake region of the Park.

The first time I heard them, or it, was on the 22d of July, about 8 A. M., on Shoshone Lake. Elwood Hofer, our guide, and I had started in our boat for the west end of the Lake. While engaged in making ready for a sounding on the northern shore, near where the lake grows narrow, I heard a strange echoing sound in the sky dying away to the southward, which appeared to me to be like a sound that had already been echoing some seconds, before it had aroused my attention, so that I had missed the initial sound, and heard only the echo. I looked at Hofer curiously for an explanation. He asked me what I thought the sound was; I immediately gave it up and waited for him to tell me, never doubting that a satisfactory explanation would be forthcoming. For once this encyclopedia of mountain lore failed to come up to date. His reply was, that it was the most mysterious sound heard among the mountains. From the first this sound did not appear to me to be caused by wind blowing. Its velocity was rather that of sound. It had all the characters of an echo, but of what I am not even yet prepared to give an altogether satisfactory answer. I am afraid that my conclusions are about as satisfactory as those of the Irishman, who having been sent out from camp in the night to investigate a strange noise believed to be made by some wild beast, returned with the announcement that "it was nothing at all, only a noise just." Upon our return to camp I questioned both our guides and one of the packers, who had had much experience in the mountains. They agreed substantially in what they had to say about it. They had never heard it farther west than Shoshone Lake, nor farther east than Yellowstone Lake, and not at all north of these lakes. Hofer thought he had heard it once about 30 miles south of Yellowstone Lake. Dave Rhodes had heard it usually shortly after sunrise and up to perhaps half-past eight or nine o'clock. Hofer said that he had heard it in the middle of the day but usually not later than ten o'clock A. M. Neither of them remembered to have heard it before sunrise.

On the following morning we heard the sound very plainly. It appeared to begin directly overhead and to pass off across the sky, growing fainter and fainter towards the southwest. It appeared to be a rather indefinite, reverberating sound, characterized by a slight metallic resonance. It begins or is first perceived overhead, at least, nearly every one, in attempting to fix its location, turns his head to one side and glances upward. Each time that I heard the sound on Shoshone, it appeared to begin overhead, or as one of the men in the party expressed it "all over," and to move off to the southwest. We did not hear the sound while on Lewis or Heart Lake. The next time I heard the sound was on August 4th, when we were camped on the "Thumb" of Yellowstone Lake. Professor Forbes and I were out on the lake making soundings about 8 A. M. The sky was clear and the lake was quiet. The sun was beginning to shine with considerable power. The sound seemed loudest when overhead, and apparently passed off to the southward, or a little east of south. It had the same peculiar quality as that heard on Shoshone Lake, and is just as difficult to describe. There was the same slight hint of metallic resonance, and what one of the party called a kind of twisting sort of yow-yow vibration. There was a faint resemblance to the humming of telegraph wires, but the volume was not steady nor uniform. The time occupied by the sound was not noted, but estimated shortly afterward to be probably a half a minute As I heard it at this time it seemed to begin at a distance, grow louder overhead where it filled the upper air, and suggested a medley of wind in the tops of pine trees, and in telegraph wires, the echo of bells after being repeated several times, the humming of a swarm of bees, and two or three other less definite sources of sound, making in all a composite which was not loud but easily recognized, and not at all likely to be mistaken for any other sound in these mountain solitudes, but which might easily escape notice if one were surounded by noises. On August 8th, at 10.15 A. M., Professor Forbes and I heard the sound again while we were collecting in Bridge Bay at the northern end of the lake.

While on Shoshone Lake I ventured the suggestion that the sound might be produced beyond the divide east of us, and be reflected from some upper stratum of air of different density from that below. Hofer evidently considered himself responsible for an explanation of the origin of the sound, and frequently remarked that it reminded him of the noise made by the escaping steam of the so-called Steamboat Geyser, on the eastern shore of Yellowstone Lake, about 6 miles from the outlet. I passed between Steamboat Point and Stevenson's Island twice, but was not near enough either time to hear the escaping steam. Moreover, on each occasion the wind was blowing a lively breeze in the direction of Steamboat Point. On the afternoon of August 9th, at 3.20 P.M. while in a row-boat on the south eastern arm of Yellowstone Lake, near the entrance of the upper Yellowstone River, I heard a sound overhead, like rushing wind, or like some invisible but comparatively dense body moving very rapidly through the air, and not very far above our heads. It appeared to be travelling from east to west. It did not have the semi-metallic, vibrating, sky-filling, echoing resonance of the overhead noises that I had heard before, and was of rather shorter duration. It had, however, the same sound-like rapidity of the other. The sky was clear except for a few light fleecy and feathery clouds, and there was just enough wind blowing to ruffle the surface of the water. If this sound was produced by a current of air in motion overhead, it is difficult to understand why it did not give some account of itself, either in the clouds that were floating at different levels in the upper air, or among the pines which covered the slope that rose more than 1000 feet above our heads, or on the waters of the lake itself.

I am inclined to attribute the typical echoing noise to some initial sound, like that of escaping steam for example, from some place like Steamboat Geyser, and which is reflected by some upper stratum of air, that is differently heated from that below by the rays of the sun as they come over the high mountain ridges to the east of the lake. The sound may thus be reflected over the low divides west to Shoshone, and south to Heart Lake, or even farther in the direction of Jackson's Lake. I am not strenuous for this theory, and will be glad to hear a better explanation of this phenomenon. I have a dim recollection of some legend of phantom huntsmen, and a pack of ghostly but vocal hounds which haunt the sky of the Hartz Mountains. Can any one tell whether there is any natural phenomenon belonging to mountains or mountain lakes, which could give foundation to such legend?

The phenomenon has not yet been successfully explained, and I do not know that any similar phenomenon has been observed elsewhere.

It is to be hoped that some one will investigate the matter soon and give a scientific explanation of its cause.

THE PLACE OF MUSEUMS IN EDUCATION.

BY THOMAS GREENWOOD, LONDON, ENGLAND.

The most casual observer of educational methods could not fail to notice that the receptive mind of a child or a youth learns from an infinite variety of sources. We all know that we begin at one end of education, but there is no period in life of the most aged where the other end is reached. Frequently, again, that information which does not absolutely form part of the ordinary process of education, but which comes from unexpected quarters, is of as great a service in the development of the mind as any set lessons can possibly be. Whatever becomes suggestive to the mind is of educational value. That Museums have from their very nature the very essence of this suggestiveness is patent. It may be true that of themselves alone they are powerless to educate, but they can be instrumental and useful in aiding the educated to excite a desire for knowledge in the ignorant. The working man or agricultural laborer who spends his holiday in a walk through any well-arranged Museum cannot fail to come away with a deeply-rooted and reverential sense of the extent of knowledge possessed by his fellow men. It is not the objects themselves that he sees there, and wonders at, that cause this impression, so much as the order and evident science which he cannot but recognize in the manner in which they are grouped and arranged. He learns that there is a meaning and value in every object, however insignificant, and that there is a way of looking at things common and rare, distinct from the regarding them as useless, useful, or merely curious. These three last terms would be found to be the very common classification of all objects in a Museum by the uninformed and uninitiated.

After a holiday spent in a Museum the working man goes home and cons over what he has seen at his leisure, and very probably on the next summer holiday, or a Sunday afternoon's walk with his wife and little ones, he discovers that he has acquired a new interest in the common things he sees around him. He begins to discover that the stones, the flowers, the creatures of all kinds that throng around him are not, after all, so very commonplace as he had previously thought them. He looks at them with a pleasure not before experienced, and talks of them to his children with sundry references to things like them which he saw in the Museum. He has gained a new sense, a craving for natural knowledge, and such a craving may, possibly, in course of time, quench another and lower craving which may at one time have held him in bondage—that for intoxicants or vicious excitement of one description or another.

The craving for intoxicants or excitement is often as much a result as a cause. The toilers have few things to occupy their mind, and frequently in their home surroundings much cheerlessness and discomfort. Life is for very many a hard daily grind for mere existence, with little or no relief from the daily round of the struggle to make ends meet. These, and other conditions under which so many live, cannot fail to produce tastes and likings which are not qualified to tend to the uplifting of the mind and the desires by which their life is governed.

It is only those who come closely in contact with the more intelligent of the working classes, who know the nobility of character and the earnest reaching out towards higher things to be found among them, who can be familiar with the intense longing to have within their reach institutions such as Museums, Art Galleries, and Free Libraries, to which they can have easy access. That such as these use the institutions which already exist is most amply and conclusively proved by the ocular demonstration of those who have visited the Museums in any of the large towns of the country.

The nation should never forget that some of its greatest benefactors have belonged to this class of intelligent working men. James Watt, the engineer, Hugh Miller, the stonemason geologist, Stephenson, the collier-railway projector, Arkwright, the weaver-inventor, and scores of others who could be named. Where, indeed, should we have stood as a nation had it not been for the sturdy common sense of the intelligent and thrifty working classes?

Until very recently the great defect of our system of education has been the neglect of educating the observing powers—a very distinct matter, be it noted, from scientific or industrial instruction. The confounding of the two is evident in many books which have from time to time been published. There are not a few who seem to imagine that the elements that should constitute a sound and manly education are antagonistic; that the cultivation of taste through purely literary studies and of reasoning through logic and mathematics, one or both, is opposed to the training in the equally important matter of observation through these sciences that are descriptive and experimental. There is considerable inconsistency in any such idea, and educational leaders are now universally recognizing the need there is for not giving too much attention to one class of mental training to the exclusion of the rest. Equal development and strengthening of all are necessary for the constitution of a well-ordered mind.

A consensus of opinion is now apparent that this method is erroneous, and the Universities are taking the lead by emphasizing to a less degree the merits of a purely classical education. The conductors of private schools, again, are beginning to see the great need which exists for a practical acquaintence with the leading Continental languages, and the Board school curriculum is rapidly becoming to mean a year or two devoted to technical instruction and manual training. It is almost impossible satisfactorily and effectually to conduct the latter without the aid of Museums, and these institutions are destined to occupy a most important place in this respect. Specimens of raw materials with labels clearly defining their properties and uses, and the relation that one kind of raw material bears to another kind, are now, in many instances, looked upon as indispensable scholastic aids.

The Manchester Exhibition was particularly useful in this respect, for there were many sections in which the various stages of the raw material up to the perfected article were shown, and it may safely be stated that no exhibition of modern times possessed in this way a wider and more real educational value than the very successful one held in Manchester in 1887. The silk, chemical, pottery, and other sections were especially complete in this respect. The number of models of an almost infinite variety in these departments had a value attaching to them as a means of instruction, which could not fail to be useful to the many thousands of the youth of both sexes who visited the buildings at Old Trafford.

Vast collections of objects, whether in Museums or Exhibitions for educational purposes, do not always accomplish the object in view. Doubtless the vastness of the collections in some of own Exhibitions in London, and those which have been held in other cities, has been very impressive, but it may be gravely questioned whether any mind has carried away many useful impressions from the infinite multitude upon which he has had an opportunity of looking. The general mental state very frequently produced by such a numerous display is that of distraction. There is such a state of mind as picture drunkenness or Museum drunkenness, and this should be carefully guarded against. There should be in Museums and Art Galleries a more extensive use of folding screens, so that anyone so disposed could shut themselves off from the crowd while they study a case or a picture minutely. A few striking objects well and carefully studied are infinitely better and of greater educational worth than a number of things at which there is only a casual glance.

Modelling, whether in cardboard, wood, or clay, is an invaluable means of cultivating and developing the manipulative skill of youths. All know how readily a boy will take to the construction of a boat, or a girl to dress a doll, and in this lies the indiction that most young people will take as readily to modelling as the boys do to cricket and the girls to their skipping ropes.

Charles Kingsley, addressing working men, with reference to their requirements, says: "We must acquire something of that industrious habit of mind which the study of Natural Science gives. The art of seeing, the art of knowing what you see, the art of comparing, of perceiving true likenesses and true differences, and so of classifying and arranging what you see, the art of connecting facts together in your own mind in chains of cause and effect, and that accurately, patiently, calmly, without prejudice, vanity, or temper."

The late Ralph Waldo Emerson, writing on the same subject, says: "Manual labor is the study of the external world." This kind of manual labor should be taught in schools. Children's habit of collecting and arranging objects of interest should be encouraged. The study of a single branch of natural science, such as constructive botany, may be made the means of cultivating habits of neatness, order and skill. The analysis of plant forms would illustrate the application of geometry to ornamental purposes, and open up wide fields for the development of decorative taste and manipulative skill. But cramped by the restrictive rules of our result system, these sources of useful culture are neglected; and, therefore, our children are turned out of the educational mill imperfectly prepared for the further processes necessary to qualify them for taking their part in the struggle for existence.

All this proves the necessity for Museums having the closest possible connection with elementary as well as advanced education. The uses of constructive botany, as referred to in the short quotation from Emerson, are especially helpful as a suggestive study to the mind. For this branch of education Museums are the best text-books which can be provided, but in order that specimens in these branches of natural science be properly and usefully studied they require to be explained by competent teachers. It is in this respect that practical and efficient curators can be of the greatest service in giving short and informal explanations of some of the specimens in their Museums.

As far back as 1853, there was delivered at the Museum of Economical Geology, in London, a lecture by the late Professor Edward Forbes, on the Educational Uses of Museums. In one part of this lecture he spoke as follows: "In their educational aspect, considered apart from their educational applications, the value of Museums must in a great measure depend on the perfection of their arrangement, and the leading ideas regulating the classification of their contents. The educated youth ought, in a well-arranged Museum, to be able to instruct himself in the studies of which its contents are illustrations, with facility and advantage. On the officers in charge of the institution there consequently falls a heavy responsibility. It is not sufficient that they should be well versed in the department of science, antiquities, or art committed to their charge. They may be prodigies of learning, and yet utterly unfitted for their posts. They must be men mindful of the main end and purpose in view, and of the best way of communicating knowledge according to its kind, not merely to those who are already men of science, historians, or connoisseurs, but equally to those who, as yet ignorant, desire to learn, or in whom it is desirable that a thirst for learning should be incited." Among the most useful Museums are those which are made accessory to professional instruction, and there are many such in the country, but almost all confined to purposes of professional education, and not adapted or open to the general public. The Museums of our Universities and Colleges are, for the most part, utilised in this way, but the advantages derived from them are confined to a limited class of persons.

This educating the children in the schools in the elements of natural science is most essential, especially in country districts. When persons reach mature age without knowing anything about Natural History objects, they find it is then too much trouble to investigate these subjects. But by getting at them when young, by simple and forcible illustrations, they are bound to carry it forward with them to a certain extent, and if there should come a time when they are in a position to give time to study, the first they will take up and pursue with patience will probably be some subject of this nature, merely for the pleasure of the study. On the other hand, if they have no inclination to work, they will not forget the pleasant hours they spent when they sat listening to some explanation of an object so familiar, which will create a tendency to put their hands to the bottom of their pockets and act feelingly. If children could be taught to see God in Nature and the wonders which He controls, without cramming the brain with so much theory, by giving them a run into the country along with some one to explain, it would conduce a great deal more to their general health and happiness. Country Musueums want illustrating and simplifying as much as possible. Call a spade a spade, *i. e.*, give the local name as well as the scientific one. This education would be another great saving to the nation if it were universal. Half the things that are dug up now are only saved by the merest chance, because the men digging do not care what they are striking their pick through. This would be altered altogether if they had been taught in early youth to take notice of the value and interest there is attaching, often, to things dug up from the earth.

Thirty-five years ago Professor Forbes said: "I cannot help hoping that the time will come when every British town even of moderate size will be able to boast of possessing public institutions for the education and instruction of its adults as well as its youthful and childish population; when it shall have a well-organised Museum wherein collections of natural bodies shall be displayed, not with regard to show or curiosity, but according to their illustration of the analogies and affinities of organised and unorganised objects, so that the visitor may at a glance learn something of the laws of nature; wherein the products of the surrounding district, animate and inanimate, shall be scientifically marshalled, and their industrial applications carefully and suggestively illustrated; wherein the memorials of the neighbouring province, and the races that have peopled it, shall be reverently assembled, and learnedly yet popularly explained; when each town shall have a library, the property of the public, and freely opened to the well-conducted reader of every class; when its public walks and parks (too many as yet existing only in prospect) shall be made instructors in botany and agriculture; when it shall have a gallery of its own, possibly not boasting of the most famous pictures or statues, but nevertheless showing good examples of sound art: examples of the history and purpose of design, and, above all, the best specimens to be procured of works of genius by its own natives who have deservedly risen to fame. When that good time comes true-hearted citizens will decorate their streets and squares with statues and memorials of the wise and worthy men and women who have adorned their province—not merely of kings, statesmen or warriors, but of philosophers, poets, men of science, philanthropists and great workmen."

How far are we from yet realizing this ideal, and how slowly we seem to progress in so desirable a direction! Still there are many signs that the conscience of the nation is at last awakened, and if we see to it that all the discussions at present filling the air do not end simply in talk, but that practical good shall be the outcome, then our progress during the coming twenty-five years will not be so discouraging. In no better way can this ideal be realized than by an acute recognition of the place Museums should occupy in our national system of education.

LETTERS TO THE EDITOR.

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

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

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

Feigned Death in Snakes.

After reading the letter on "Feigned Death in Snakes" in *Science* of Oct. 13, one is left with the impression that Heterodon, or the "blowing viper," or, as he is known in New Jersey, the "adder," actually bites itself in the side and then pretends to die.

As the adders are very common in the southern part of this state, I have had countless opportunities for watching this habit of feigning death and have never seen anything like an attempt, or even a pretended attempt, to bite themselves. The teeth of Heterodon are hardly large enough to scratch a tender hand, much less bite through or between the heavy folds of the snake's horny skin. How this supposition came about is easily seen, when the snake, after finding it cannot escape, is about to turn over on its back, throws its mouth wide open, tucks its head under its body and suddenly twists over, the whole affair, unless carefully watched, looks decidedly suicidal. But the snake has not bitten itself and had no intention of so doing.

The account referred to is quite right in believing that this is not a "faint from fear." The convolutions of the serpentine hemispheres are undoubtedly well twisted, but we can hardly credit the reptile with so delicately a balanced organism as to admit of its fainting.

The measure, I believe, is purely a protective one, and often of the greatest service. Heterodon is the slowest and most clumsy of all our snakes, and as it cannot depend on flight for safety, it needs other means for protection, of which this trick in question is among the best, as is also its beautifully adaptive coloration. The spewing out of the contents of the stomach is similar to that habit in turkey buzzards and many other creatures, and an additional aid in escaping their enemies.

The whole affair, then, is not a "pretended suicide" but a pretended death, with a stink solely for the snake's protection. Dallas L. Sharp.

Bridgeton, N. J., Oct. 24.

The Destruction of Wild Plants.

The destruction of wild plants by students of botany and collectors has become appalling. Botany is becoming a universal study in the schools, and one hundred young people each gathering one plant to use and ten to twenty to throw away, soon exterminate the rarer plants.

The solution of the problem is at hand. Let teachers use only cultivated plants in their work. Of these an abundance can always be had. Turn the attention of students from the mere collection and analysis of plants to the more important subjects of plant physiology and economic botany. The time has come for a change.

G. G. Groff.

Lewisburgh, Pa.

Minnesota Mounds.

In reply to Mr. F. B. Sumner's criticism on my notes on Minnesota Mounds I would state that he should point out and correct some of my "gross misrepresentations" instead of indulging in absurd statements not bearing on the subject. Would also suggest that he read the article again and with more care. Though Mr. Sumner has considerable ability in certain lines yet his youth and lack of special training should prevent him from criticising ideas acquired by considerable study and experience. Criticisms should be made with care.

ALBERT SCHNEIDER, M. D.

Weston, Ill., Oct. 26.

SLATE BLACK-BOARDS.

ATTENTION has been called to the fact that light is reflected from slate black-boards in an injurious manner. One city superintendent informs the writer that he has been compelled to lessen the amount of work to be copied from the board. A county superintendent writes that he cannot sit in a certain high school without experiencing painful sensations, if he faces the slate boards.

Have other teachers observed the same? Is a slate board more trying to the eyes than slated surfaces? Is a slated surface to be preferred to a true slate board?

Will not superintendents and teachers who care for the general health of the children in their charge, and especially for the eyesight of the children, communicate with the subscriber in reference to this matter? Answers to the questions are earnestly solicited. Address,

DR. GEO. G. GROFF,

Lewisburgh, Pa.

A GROOVED AXE IN A STRANGE PLACE.

SOME months since while making observations with Mr. Haldeman O'Connor, of Harrisburg, on an island in the Susquehanna, not far from the city, we came across a perpendicular exposure of a clay bed, from the face of which several feet of earth had been removed by a recent flood. Several bowlders were imbedded in its face and one of them, *eight feet from the top*, on account of its peculiar shape, attracted attention, and on removal proved to be a grooved axe, well made of a heavy, close-grained sandstone, about six and a half inches long and two and a half inches wide, having a good cutting edge and a perfect groove—somewhat weathered but not differing in any particular from the many found on the surface. The bed in which the implement was found is a compact clay, the lowest and the last of the terrace deposits of the valley and consequently, geologically speaking, comparatively recent.

Any method, save one, to account for the presence of the axe in this position, was of no avail. The clay bed seemed to be unquestionably undisturbed, and no theory of trap roots nor upturning of trees would explain it. Did the axe find this resting place—eight feet below the surface—during the deposit of the bed? If it did its maker, whoever he was, must have lived about the same time,—some thousands of years ago, when the last of the prehistoric floods swept down this old valley, and the origin of Neolithic man, if such he was, must be placed at an early date.

HARVEY B. BASHORE.

West Fairview, Pa., Oct. 1.

THE SYSTEMATIC POSITION OF THE DIPTERA.

IN *Science* No. 558 for October 13, Dr. Packard has an article upon this subject, in the general conclusions of which I most heartily agree. Dr. Packard has not mentioned, by any means, all of the arguments in favor of his view, and some of these will be, I hope, presented by Dr. Riley, who has already suggested them in lectures,, although they are not, so far as I am aware, published. There are a few points upon which Dr. Packard's paper is not entirely clear, or where, at least, I do not seem to be able to understand him entirely. He mentions, in one place, as characteristic of the Diptera the "abolition of mandibles (Simulium excepted)." In another place, the fact that the jaws are wanting, and finally speaks of the mosquito, eepecially the female. in which mandibles and maxillæ are said to be well developed. The first statements are correct; but I must take issue with Dr. Packard on the statement that the mandibles are well developed in the mosquito, for, as a matter of fact, there is no trace of these organs in that insect· All the piercing and enveloping structures are, as I have shown, homologous with other mouth structures. It is further stated that the maxillæ are usually much reduced, while the labium is enormously developed and highly modified. I have, I think, shown very conclusively that the enormous development in the Dipterous mouth parts takes place in the maxillary structures and that the labium is in most cases very much reduced if not entirely wanting. The best development of this latter organ is seen in the piercing flies related to *Tabanus*, in which we are able to trace every part of the normal structure of the labium of a mandibulate insect. Dr. Packard's article reads as if he partially accepted and partially rejected my conclusions concerning the mouth structures of the Diptera, and I would be rather interested to know how far he considers my conclusions in that order well founded. The reference to the mouth parts is really not needed in order to support his claim, and in some directions the Dipterous mouth is certainly very much more highly specialized than that of the Hymenoptera.

JOHN B. SMITH,

Rutgers College, November 1st.

BOOK-REVIEWS.

A Guide to Stereochemistry, based on lectures delivered at Cornell University, with an index to the literature. By ARNOLD EILOART, Ph.D., B.Sc. New York, Alexander Wilson, 26 Delancey street. 96 p. with appendix, paper, 8vo., Ill. $1.00, postage free.

THE want of a suitable text-book upon this deeply interesting new branch of chemistry, the geometrical relations of atoms in space, has long been felt. The literature is widely scattered and so fragmentary as to make such a "Guide" as this offered by Dr. Eiloart of utmost value to student and professor alike; to the latter as an aid in the preparation of his lectures and to the former as a digest of these lectures, with an indication of the lines and means for more extended study. Unfortunately, in many colleges this department of research is barely touched upon, not for lack of interest, however, but because with the limited time commonly at the disposal of the professor detailed correlation even of the work in this field is an impossibility.

While the study of structural isomerism dates from 1824, the actual development of stereochemistry begins about 1873—a retardation of extraordinary length, considering the easy step from one to the other. Isomerism conceives of compounds containing the same elements in the same proportions, and yet differing in properties, this difference being due to a different grouping of these elements. Geometrical isomerism conceives of compounds containing the same elements in the same proportions and arranged in the same groups and yet differing in properties because of a different arrangement *in space* of the constituent groups. The second conception is thus a natural outgrowth from the first. Dr. Eiloart passes with a few words the accepted facts of stereochemistry giving more particular attention to the living issues and more daring developments. The index to the literature is most carefully planned and is more than a mere list of titles, insomuch as it gives by means of suitable abbreviations an idea of the contents of the papers referred to. An appendix with photographic plates, five in number, treats of the use of "Solid Formulæ," or models in the teaching of organic chemistry. The book is copiously illustrated throughout with diagrams and woodcuts.

C. P.

Primer of Philosophy. By Dr. Paul Carus. Chicago, Open Court Pub. Co., 12mo., $1.

This book, notwithstanding its title, is the most elaborate work on general philosophy that Dr. Carus has yet published. The philosophical system that he advocates is in the intellectual sphere what he calls positivistic monism, and in the moral sphere meliorism. By monism he means that "soul and body, * * * are the too inseparable sides of our existence; they are two abstracts from one and the same reality" (p. 23). His monism evidently is the kind that is known as materialistic monism; for he does not believe in the soul as a distinct entity, but says that "a human personality is merely a society of ideas." The main object of this book, however, is to set forth the author's views on the subject of what Kant called *a priori* truths, and to reconcile, if possible, the views of Kant with those of Mill. Dr. Carus holds with Kant that "logical, mathematical principles are universal and necessary;" but on the other hand, he maintains with Mill that all our knowledge comes from experience. The question he has to answer, then, is how universal and necessary truths can be derived from experience, which consists entirely of particular perceptions; and we cannot think that Dr. Carus is any more successful in answering this question than others have been before him. He sees that universal truths cannot be get out of sensuous experience, yet he cannot accept Kant's view that they are known before experience; and he advances the opfnion that such truths, or axioms, are "products of rigidly formal reasoning." To this the obvious reply is that there can be no formal reasoning without premises, and that, if the conclusion is to be valid, one of the premises must be universal; and furthermore, the principle of reasoning itself must be universal if the conclusion is to be sound. But while we cannot think that Dr. Carus has solved the problem he has taken in hand, we have been interested in reading his book and have found much in it that is suggestive. It shows throughout the moral earnestness and the desire to be useful that mark all its author's works, and will well repay perusal.

Essays on Rural Hygiene. By George Vivian Poore, M. D., F. R. C. P. London and New York, Longmans, Green, & Co. 321p, 8 vo.

For thirteen years honorary secretary and subsequently vice-chairman of the Parkes Museum of Hygiene, Dr. Poore is well qualified as an experienced sanitarian and his word in hygienic matters carries the weight of practical experience. Many of the chapters of the above-named work has been previously published, while others have been delivered as addresses before the University College, London, and before various scientific societies. The book has, however, a perfectly preserved plan and is in no sense a disjointed collection, nor does the former publication deduct from the interest, as unfortunately Dr. Poore's ideas of sanitation are totally at variance with the popular acceptance of that term and are not such as would be given wide publicity. The world has accepted very quickly the call for improved sanitary methods finding the subject, considered as a principle, one readily grasped by minds little trained in the sciences, and at the same time one which appeals very closely indeed to the comfort and health of the home. Unfortunately, however, this fervor of sanitation has opened the path for hundreds of banditti patentees and political highwaymen who have quickly seen andappreciated their opportunity, and who, from the ambush of "science" have rushed out and seized upon the public pocket-book. That the public has made so little resistance and has always so smilingly "held up its hands" is perhaps to its credit in a way, for it thereby exhibits a readiness to co-operate with science and it can not be expected to distinguish between the true and the false. But people like to pay well for public improvements and very probably if offered their choice between the modest and enonomical means proposed by Dr. Poore, and the criminally expensive processes urged by city boards, would unhesitatingly prefer the latter. We rather like beiug robbed by gallant knight of the mountains with bright colored scarfs and ornamental trappings. We can talk about it afterwards, boast of it in fact, and the more we have lost the prouder we are.

A point well developed in these essays is the evil of concentration of population, and, together with this, the ever-growing problem of proper water supply and of sewage disposal. The question of pure air is discussed, and also the purifying power of "the living earth." Cities now committed to the evils of expensive and wasteful water supply, with all the accompanying difficulties and snares of sewage and sewage disposal, Dr. Poore very properly leaves without his discussion; they have gone so far as to make a turning back well nigh impossible. Where the end will be he does not even conjecture. It is to the rural and suburban population that he appeals, and most ably, for a consideration of certain means by which, upon a thorough scientific basis, they can secure an efficient sanitation for their homes, a pure water supply and an increased land value, all at a minimum of cost. Nor is this rested upon theory alone; the practical working in all details has been developed in the author's suburban home, and the same means there used by him are open to all of us who have that blessing of a small piece of ground, and who are not condemned to live in a "flat." C. P.

A Laboratory Manual, Containinq Directions for a Course of Experiments in Organic Chemistry. By W. R. Orndorff, A. B., Ph.D., Assistant Professor of Chemistry in Cornell University. Boston, D. C. Heath & Co. 1893. Interleaved.

The above manual is designed to accompany Remsen's "Organic Chemistry," and is systematically arranged as a laboratory companion to that book. It contains a course of experiments, eighty-two in all, graded in careful manner, leading on from the elementary principles of organic analysis, fractional distillation, the determination of melting points, etc., to the more advanced synthetical preparations. The procedure of the various operations is admirably given in few but comprehensive directions, and the experiments as described would present no difficulties to a beginner in the study. While parallel to Remsen's book, it is more explicit, and gives greater detail of manipulation. The author's experience as a teacher has enabled him to select carefully the best conditions of experiment and to present them clearly to the student.

C. P.

—D. Appleton and Company have published a large octavo volume containing "Speeches and Addresses of William McKinley." They are mostly of a political character, and, as will be surmised, a large number of them are in advocacy of the protective tariff. Mr. McKinley is well known, not only as one of the leading advocates of the protective system, but also as the author of the existing tariff, and his prominence in the matter will make this book useful even to his political opponents. His views are so generally known, however, that we need not expound them here, and any discussion of them or of the protective system in these columns would be out of place. He expresses himself clearly and forcibly, and whoever wishes to become familiar with the protectionist theory in its extreme form will find it set forth in these pages. Many of the speeches in this volume, however, are on subjects of an unpartisan character, such as those commemorating the life and work of Grant, Garfield and other prominent men, together with several delivered on anniversary occasions. The author's enthusiastic patriotism—sometimes too enthusiastic, as it seems to us—appears in almost all of them, as well as his straightforwardness and earnestness. The general reader will be particularly pleased with his remarks on the public school system and his eulogy of the early New Englanders, and with his hearty appreciation of the eminent men whom he has known in public life. His strong partisanship, which shows itself so often, is not always pleasing to men of more moderate views; but in a country that is governed by parties it is necessary to know what the party leaders are thinking, and in this respect this volume will be useful to all students of American politics.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For exchange.—Skins of Aegialites nivosa, Ereuneter occidentalis, Aunnodramus Arldingi. A. rostratus, Chamara tasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diago, California.

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

For Sale.—A collection of fossil Rhinoceros bones (Aphelops fossiger Cope.) from the Loup Fork Tertiary, including all the bones of one fore and one hind leg, the pelvis, representative vertebrae and ribs, and a nearly complete skull, with complete lower jaws. All the bones of the limbs are perfect. Price $250. Address Dept. of Paleontology, University of Kansas, Lawrence.

Wants.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

SCIENCE

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SCIENCE

NEW YORK, NOVEMBER 10, 1893.

THE WASHINGTON ANTHROPOLOGISTS ASK FOR A DEFINITION—THE CHIEF JUSTICE AND THE VICE PRESIDENT WILL DETERMINE ITS QUALITY.

THERE is a product of our country that far exceeds in value all its cotton, its corn and its useful minerals. We have no lines of figures in our census returns to set forth this value; the product is so nearly inestimable that we have not as yet discovered a method of tabulating and expressing its worth. Thousands of millions of dollars would certainly fail to cover its cash cost to the commonwealth. Our schools, our colleges, our churches, and our domestic hearths are established and maintained to form and fashion this precious product, and a large part of the time and energy and the best and longest thoughts of our noblest men and women are dedicated to the same important end.

This infinitely valuable, this inestimable product is—the useful citizen.

It is manifest that among the hundreds of thousands of useful citizens nurtured and sent forth into the battle of life there exists the widest difference in character and capacity, and, consequently, the widest difference in their individual value to the state.

When we rehearse their services and sum up in our minds how much our country has been bettered and aggrandized by Abraham Lincoln, Benjamin Franklin, Peter Cooper, C. P. Huntington, Robert Fulton, Thomas Edison, and James Russell Lowell, and imagine our national existence deprived of their work and influence, we comprehend the enormous relative value of such men to the commonwealth. Indeed, is it too much to say that the nation could better afford to lose, by emigration to some pleasant foreign clime, the entire population of one or more of our forty-four states, rather than have blotted from our history the work and influence of the seven fellow citizens we have named?

These men performed their great services for us, for our nation, and for humanity because they were possessed of certain qualities, faculties and characteristics that gave them power to perceive, grasp, mould and control the elements around them, and such desirable attributes are possessed, in a greater or less degree, by every useful citizen. But in the *most useful citizen* will be grouped the most desirable and most useful characteristics in the greatest number and of the highest quality.

That they are sometimes so grouped that in one man may exist the potentiality of becoming the most useful citizen in whatever occupation or environment he may thereafter attain to in the community, is shown by a consideration of the best-known of the persons mentioned—Benjamin Franklin.

We find this individual, in the most widely differing relations in life, performing his part with admirable perfection. He was a good journeyman printer and a skilful manufacturer and publisher. His part as a shopkeeper he played well. He excelled as an inventor of the most diverse contrivances, such as stoves, musical instruments and electrical apparatus. He was a philosopher of high rank, and for his accomplishments in statescraft his countrymen will always honor his memory. His faculty and foresight in founding and fostering public institutions of benevolence and literary and scientific culture is patent to us after the lapse of a century and a half. His eminence as a diplomat is conceded, and as a man of the world, of tact, of brilliant social attainment, his experience at the French court bears ample testimony. Every one acknowledges his singular ability as an editor, as a polemic, and as a humorist. Of his aptitude as a linguist, a financier, a military leader, an orator, a postmaster general, a physical geographer and as a public-spirited citizen, history gives sufficient proof.

Now all the elements that produced this high degree of usefulness in so many forms of desirable human activity, existed potentially in the citizen Franklin when aged seventeen he landed in Philadelphia, and strode up Market street with his loaf of bread under his arm. He then possessed his vigorous muscular system, his fine digestion, his well-balanced physique, his strong social instincts, his active brain, with its scores of functions working harmoniously, his quick, responsive nerves, his optimism, his enterprise, his undaunted will, his abiding patience, his ingenuity, his economy, his sound judgment, his self-reliance, and a score of additional qualities which modern science, armed with every device that invention can conceive, is striving to weigh, measure and define.

It is a description of a bases of character such as is here outlined, given in terms as accurate as the most advanced knowledge will permit, that, we assume, the Anthropological Society of Washington seeks when it asks, in the following announcement, for a definition, in 3000 words, of "The most useful citizen of the United States, regardless of occupation:"

"A member of the Anthropological Society of Washington "has placed in the hands of the Treasurer of the Society a "sum of money to be awarded in prizes for the clearest "statements of the elements that go to make up the most "useful citizen of the United States, regardless of occupa-"tion. The donation has been accepted, and the Society "has provided for the award of the following prizes during "the present year (1893) under the following conditions:

"Two prizes will be awarded for the best essays on the "subject specified above, viz: A first prize of $150 for the "best essay, and a second prize of $75 for the second best "essay among those found worthy by the commissioners of "award.

"These prizes are open to competitors in all countries.

"Essays offered in competition for the prizes shall not "exceed 3,000 words in length, and all essays offered shall "be the property of the Anthropological Society of "Washington, the design being to publish them at the "discretion of the Board of Managers, in the official organ "of the Society, the *American Anthropologist*, giving due "credit to the several authors.

"Each essay should bear a pseudonym or number, and "should be accompanied by a sealed envelope bearing the "same pseudonym or number, and containing the name and "address of the competitor; and the identity of competitors "shall not in any way be made known to the Commission-"ers of Award.

"Essays must be type-written or printed, and must be "submitted not later than November 1, 1893. [Since "changed to March 1, 1894.]

"While it is not proposed by the Society to limit the "scope of the discussion, and while each essay will be con-"sidered on its merits by the Commissioners of Award, it is "suggested, in view of the character of the Society and the "wishes of the donor of the prize fund, that the treatment "be scientific, and that the potential citizen be considered

"(1) from the point of view of anthropology in general, "including heredity, anthropometry, viability, physiological psychology, etc.; (2) from the point of view of personal "characteristics and habits, such as care of the body, "mental traits, manual skill, sense training and specialization, and all-round manhood; and (3) from the ethical "point of view, including self-control, humanity, domesticity, charity, prudence, energy, *esprit de corps*, patriotism, "etc.

"The essays offered in competition for the citizenship "prizes of the Anthropological Society of Washington will "be submitted, on or about November 2, 1893 [changed to "March 1, 1894,] to five Commissioners of Award, including, it is proposed, one anthropologist, one jurist, one "statesman, one educator, and one other not yet specified, "all of national reputation, of whom at least one and not "more than two shall be members of the Society; and the "award shall be made in accordance with the findings of "these Commissioners.

"The award will be made in accordance with the finding of the following-named five Commissioners, whose "acceptances were announced in the *Anthropologist* for November:

"Dr. Daniel G. Brinton, of the University of Pennsylvania; Dr. Daniel C. Gilman, President of Johns Hopkins University; Melville W. Fuller, Chief Justice of the "United States Supreme Court; Adlai E. Stevenson, Vice-President of the United States, and Dr. Robert H. Lamborn.

"Essays submitted in competition for the prizes should "be delivered not later than November 1, 1893, [changed to "March 1, 1894], to the Secretary of the Board of Managers "of the Society, Mr. Weston Flint, No. 1101 K street, N. W., "Washington, D. C., to whom all correspondence relating "to the prizes should be addressed."

NOTES AND NEWS.

We have received from Cyrus W. Bardeen, of Syracuse, a number of his educational publications. One of them is a paper of his own on "The History of Educational Journalism in the State of New York," which he read at the Columbian Exposition in July. It gives a very full account of the various educational periodicals that have at different times been published in the State; and most readers will be surprised at the number of them. Unfortunately, their quality has not been comparable to their number; but there is reason to think that the historian of the next century will be able to chronicle an improvement in this respect. Another of the books referred to is a brief paper on the "History of the Philosophy of Pedagogics," by Charles W. Bennett. The author was formerly a theological professor, and we judge that the book is a syllabus of lectures that he sometimes delivered, for it is a mere outline suitable only as a basis for oral teaching. The most interesting book in the collection is that on "The Educational Labors of Henry Barnard," by Will S. Monroe, being a brief biography of Dr. Barnard with some account of his educational writings. The processes of his own education are very briefly described; but a fuller account is given of his work as Superintendent of Schools in Connecticut and Rhode Island, in which capacity his labors were of much use in improving the public school system of the country. In later years Dr. Barnard has been president of two different colleges, and also U. S. Commission of Education. The work by which he is best known among educators, however, is his *American Journal of Education*, of which thirty-one volumes have been published. This work, as Mr. Monroe remarks, "is not a school journal or review in the accepted use of those words, but * * * a vast encyclopædia of educational literature." It treats of every aspect of education, and its reputation among educators is very high. Besides these various books about the history and theory of education, Mr. Bardeen has lately published "The Limited Speller," by Henry R. Sanford, comprising an alphabetical list of such ordinary words as are liable to be misspelt, with such directions for pronunciation as are deemed necessary.

—Cyrus W. Bardeen, of Syracuse, has issued a reprint of a work on "Education and Educators," by David Kay, which was published in England some ten years ago. The book contains nothing specially fresh or original, but it is sensible, and sets forth most of the fundamental requisites of education clearly and well. The end and aim of education, according to Mr. Kay, is the perfection of man; but his ideas of perfection are somewhat utilitarian in character, for he also holds that he is the best educated man who is best fitted for the duties he may be called upon to discharge. He points out the necessity of exercising all the faculties as the only means to their development; but thinks this exercise is best obtained in the acquisition of useful knowledge. He lays special stress on the need of moral training, and devotes a whole chapter to the relation of education to religion. In the chapter on the different kinds of educators, the author points out how large a portion of our education comes from the circumstances in which we are placed and from the persons whom we come in contact with in the early years of life; and he also dwells with earnestness on the duties of the mother as the chief educator of the child. On the special subject of school education Mr. Kay says but little, his whole work being devoted to the principles of education rather than to their practical application. The most peculiar feature of the book, and in the author's opinion the most valuable, is the abundance of foot-notes, consisting of quotations from a great variety of authors on all the subjects touched upon in the book, and containing at least twice as much matter as the text itself. The selections, though quite short, are well made, and will furnish much food for thought to the thoughtful and diligent reader.

—Along the line of activities in scientific knowledge mention may be made of the Isaac Lea Conchological Chapter of the Agassiz Association. This was the first society formed in the United States for the study of conchology and malacology, having no place of meeting, nor course of lectures, but depending entirely upon correspondence. Yearly reports of work done by the members are required, and these reports form the "Transactions" of the chapter. Four volumes of transactions have been issued in manuscript. The chapter is composed of members from the Atlantic to the Pacific Ocean. Many of these members are well known as conchologists. Members correspond with one another, exchange specimens and help each other in scientific work. The chapter is divided into biological and geographical sections for the study of land, fresh water and marine shells. It also has a section for the study of fossil shells. A juvenile section has recently been added to the society which promises to be an important feature. It hopes soon to have a good working microscopical section for the study of odontophores or radula of mollusks, as well as microscopic shells. There is no admission fee, and the merely nominal sum of fifty cents covers the annual dues. Applicants for membership should address the President, Prof. Josiah Keep, author of "West Coast Shells," Mills College, California, or Mrs. Burton Williamson, General Secretary, University, Los Angeles County, California.

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

SOME RECENT ECONOMIC AND SCIENTIFIC QUESTIONS IN ORNITHOLOGY.*

BY R. W. SHUFELDT, M. D., WASHINGTON, D. C.

ORNITHOLOGY has attained to a status to-day never before reached by that science at any time within the recollection of man, or as shown by its literature.

In this country its cultivation not only interests thousands of amateurs, but its pursuit is followed by a host of eager experts, while its economic value has not altogether been overlooked by the government, which annually makes an appropriation in support of a department dealing with ornithological questions as related to agriculture. Regarded as the science is, then, from so many varied standpoints, it is not at all surprising that we find the collecting of birds actively undertaken for a great variety of purposes. Some of these are perfectly justifiable and fall strictly within the demands of the science and are essential to its progress, while others lie more or less without the pale of any such need, and consequently are deserving of our most energetic condemnation or prosecution. Thousands of birds are destroyed every year as a mere matter of sport, and either no use made of them whatever, or none worthy of mention. In this category, of course, I do not include the killing of game-birds for the table, a privilege that can be properly restricted legally, although it is very frequently more than abused. Many native birds are annually trapped for cages, and a large proportion of them perish. Quantities are destroyed by "feather-hunters" to supply the demands of fashion. Numbers are killed by ignorant farm-hands, who labor under the impression that they do humanity a direct benefit every time they take the life of a king-bird, a martin, or a marsh-hawk.

Then there are a few taxidermists who habitually destroy birds as a business, to preserve their skins and mount them for sale. As a rule, however, taxidermists are engaged only in the preservation of such birds as are brought to them, or else pursue their profession in scientific educational institutions or elsewhere.

Next we meet with every grade of amateur and scientific collector of bird-skins, who claim each year a certain proportion of specimens for scientific or semi-scientific purposes. In nature, also, some species prey upon others and thousands are thus annually destroyed, while every season the lives of millions of others are claimed by storms, high winds and downpours of heavy rain. Certain predatory mammals capture others, or reptiles devour their young. No doubt, finally, that diseases, injuries and accidents take away their annual quota, but the proportion thus destroyed must, in comparison with other causes of mortality, be exceedingly small.

Now for a number of years past it has been widely noticed that in the suburban districts of many cities all over the United States, there has been a more or less marked decrease in numbers of many of our native birds, as, for example, orioles, robins, blue-birds and many other species. Frequently such reports are only too well founded in fact, while in other cases they have been over-rated. Certain it is, nevertheless, that within the last twenty years birds in the most of such localities have been becoming more and more scarce, while in some places where certain species were formerly abundant, those very species are practically now almost extinct. Numerous inquiries, scientific and otherwise, have been made with the view of finding out, if possible, the cause or causes which are accountable for bringing about this very undesirable state of things. After more or less mature deliberation some attributed it to one cause, some to another, and some to a combination of causes. Many were disposed to believe that the introduction of the English sparrow lay at the bottom of the whole trouble; in the eyes of some the "feather-venders" had all to do with it, while from other quarters the blame was attached entirely to the taxidermists and the bird collectors. As far as the writer has seen or heard not much importance has ever been attached to any other cause as a means of destruction of bird life, with perhaps the exception of the introduction of large lighting apparatuses in many places, where no doubt thousands of birds at night are yearly destroyed.

For more reasons than one the introduction of the English sparrow into this country was an expensive blunder, but that they are chiefly responsible for the disappearance of many of our native species of birds in the localities we have mentioned, I never have in that view been a firm believer, and my faith is not increased as time goes by. In the first place, it directly militates against every personal observation I have ever made in the premises, and I have faithfully studied the species for many years. Many of our native birds whip the English sparrow in each and all contests where they come in contact, and drive them out of the nesting places. They almost invariably give way before robins, cat-birds, wrens, martins and many others. Blue-birds appear to be more timid and gentle, and they simply keep out of the sparrow's way and make no attempt to oppose him, while on three or four occasions last spring I have seen the common house wren deliberately hustle sparrows out of a bird-box, where they had bred the season before, and re-occupy it themselves.

That the indiscriminate slaughter of small birds for millinery purposes, by conscience-ridden dealers, was for a long time a prime cause has been proven beyond cavil, and such people should simply be prosecuted by all the rigor of the law, and made to desist quite as promptly as that party who would commit any act that threatened the agricultural interests of the country, for no one will question for a moment but what the removal of our insectivorous birds does that very thing. Were all the birds in the country destroyed there is no power known to man that could check the enormous increase in insect life or the destruction of plant-life that would follow as a consequence. Such a wholesale disturbance of Nature's balance will not occur; while on the other hand I am not prepared to say whether the recent known decrease in our birds in certain localities has been followed by a cor-

*Read at the World's Congress Auxilary of the World's Columbian Exposition:—Division of Ornithology. October 18-27, 1893.

responding increase of any particular species of noxious insects. That is a point for the entomologist to decide for us.

What comparatively few birds are gathered in for scientific purposes, I am strongly of the opinion, has but very little influence either one way or the other upon bird increase or decrease. Take a city like Chicago, for example, and its extreme suburban environs; how few, indeed, in proportion to her population, are there of her inhabitants who collect in the neighborhood birds for scientific purposes! In the course of a collecting season how many young scientific ornithologists in Chicago go out into her suburbs to collect birds? Not in any sufficient numbers, I warrant, to have any material effect upon the decrease of native birds. The same suggestion is applicable to other large towns and cities in the United States and Territories. When one comes to think of the millions of birds that pass over the country during the vernal or autumnal migrations *every year*, and then come to compare that host with all that has been deducted from it during the last century, as represented by all the birds actually existing in scientific collections, the loss is hardly worthy of mention. Moreover, more than half of our scientific avian collectors do not collect in the suburban districts but go far from the habitations of men, and so their work cannot be said to affect the question at all.

But there is a cause in my opinion, however, for the scarcity of our native birds in and about cities and large towns of this country, before which all other reasons we have mentioned stand absolutely aghast. It is the wholesale destruction carried on by the army of unscrupulous small boys in any particular place. I am the more convinced of this from my observations in and about Washington, D. C., during the past four years. This active destruction has been made possible by the numerous comparatively recent and cheap inventions in the way of air and spring-guns, as well as cheap rifles of small calibre, also other fatal contrivances that will noiselessly throw missiles of a variety of kinds with great accuracy. Hundreds of those guns are sold annually to boys, and the latter never seem to tire of strolling about orchards and hedge-rows and knocking over dozens upon dozens of birds with them. One day last spring I met one such youngster, and upon examining his game-bag found it absolutely crammed full of dead birds which he had killed since starting out in the morning. One item alone consisted of seventy-two ruby and golden-crowned kinglets. The same fellow boasted of having slain over one hundred cat-birds that season. Boys get to be wonderfully expert shots with the kind of guns to which I refer, and as the ammunition costs little or nothing, and a great quantity can be carried at a time, it is easy to be seen that between the wholesale slaughter they can and do commit, in addition to keeping the remaining birds perpetually alarmed, it is no wonder that they are soon driven away from the neighborhood of our cities and country seats.

There are ample legal measures within our power to enforce, to prevent this cause of bird decrease, especially if the fathers of those boys are held responsible, and I would suggest that it be the sense of this congress that such measures will be recommended to the various State legislators hereafter that will have the tendency to thoroughly discourage such practices.

A NEW THERMOELECTRIC PHENOMENON.

BY W. HUEY STEELE, M. A., MELBOURNE UNIVERSITY.

It is stated in many text-books, and pretty generally known, that electric currents may be produced by heating a single metal, if there be any variation in temper, or if the distribution of heat be very irregular and the changes of temperature abrupt. These effects are generally supposed to be exceedingly small compared with ordinary thermoelectric effects, but some experiments performed by the writer in the Physical Laboratory of the University of Melbourne show that at high temperatures these effects are sometimes exceedingly large, as great or greater than that given by a junction of antimony and bismuth at the same temperature. At low temperatures this is most apparent in iron wires, iron being the only metal in which I could observe the effect at a temperature below 100°C. If a piece of iron wire be put in circuit with a very sensitive galvanometer and gently heated irregular currents will flow, sometimes one way, sometimes the other, rising and falling in an apparently arbitrary manner. I several times observed the effect simply by warming the wire with my fingers. At a red heat the effect is much more marked and also much more irregular. The effect in iron, however, is not so great as in some other metals at a high temperature, the highest effect I observed in it being .002 volt. Altogether twelve different metals and four alloys were examined and the effect noticed in each of them. In order to raise them to a high temperature without breaking circuit by their fusing I put them through clay tubes (tobacco pipe stems), and when examining metals with low melting points I completely filled up the tube with the metal. A tube of lead when heated gave, after a little irregular heating, .3 volt, and another, with a lead wire passed through it and heated about the middle, gave about half that amount, but in this case there was no irregular or unsymmetrical heating. The effects are not always steady, in fact they very seldom keep steady, but they may be observed with certainty by filling a tube with lead and raising it to a red heat in a Bunsen flame. The effect may also be observed very easily in fine gold wire, but it does not last so long as that in lead, which shows no sign of ceasing after an hour's or half a day's heating. With gold I observed a higher effect than with any other metal, once observing nearly half a volt. .3 volt was observed with six different metals—lead, copper, gold, tin, zinc and antimony, while, with others, *e. g.*, silver and aluminum, though I could certaiuly observe the effect, it was exceedingly small. Sometimes when a metal is heated thus the changes in the electromotive force generated are slow and gradual and at times scarcely perceptible, while at others they are rapid and sometimes apparently instantaneous at a time when the temperature is perfectly steady and nothing is apparent which could cause the changes. Another curious effect is that sometimes when the temperature is falling, after the gas has been turned down or put out, there are rises, generally sudden, in the e. m. f., this was chiefly noticed in lead. These phenomena are generally quite sufficient to mask the ordinary thermoelectric effect at a red heat. and thermoelectric tables are consequently quite unreliable for high temperatures.

CURRENT NOTES ON ANTHROPOLOGY.—NO. XXXIV.

(*Edited by D. G. Brinton, M. D., LL.D., D.Sc.*)

BASTIAN ON BUDDHISM AND THE PLACE OF DEPARTED SOULS.

Religions, like all other expressions of human intelligence, will ultimately come under a rigid scientific examination at the hands of anthropologists, and the laws of their growth and change will be determined without respect to the clamors of their votaries. Of all religions, that which certainly occupies the most territory in the Old World and perhaps has the greatest number of believers is Buddhism. It has recently attracted the attention of several of the ethnologists of Europe, among them

Dr. A. Bastian, the eminent Director of the Museum of Ethnology in Berlin, who has made it the subject of a lecture (*Der Ruddhismus als religions Philosophisches System; Berlin, 1893*). As he but recently returned from the Orient, where he had unusual opportunities to study this faith in situ, his opinions are as fresh as they are profound..

Another of his lectures, published like the former with considerable additions, is upon the notions which have prevailed the world over as to the place of departed souls (*Die Verbleibs-orte der Abgeschiedenen Seele*). It illustrates with curious richness of learning the endless variety of the pictures the living have drawn concerning the fate of the soul after its departure from the body, some of the crudest being by no means confined to savage tribes.

Both lectures witness to the astonishing erudition of the author; but it is to be regretted that his style offers such difficulties to the foreign reader, and that his system of references is so vague.

Central American Ethnography.

Geographically, Central America should be held to include all the area between the isthmus of Tehuantepec and that of Panama. Using the term in this sense, I believe that no new linguistic stock remains to be discovered there; though, it is true, of some we have very little material, and of a few tribes we have not positive knowledge. The most important of these is the Guetares or Huetares, who lived near Cartago in Costa Rica, and who seem now to be extinct. Señor M. de Peralta prepared in connection with the Madrid exposition an excellent resumé of the ethnography of that state, and this was the only problem he left unsolved (Etnografia de la Republica de Costa Rica, Madrid,, 1893).

Recently, Dr. C. Sapper, of Guatemala, wrote to me that he had found an unclassified tongue spoken by a few old people at Tapachula, in Chiapas, close to the western boundary of Guatemala. At my request he kindly sent me a short vocabulary; but he himself had already by that time noted its resemblance to the Zoque-Mixe family, of which it unquestionably is a member, though the presence of this stock in that part of the map had not previously been noted.

There is a very prevalent error that the Caribs had settlements in Central America. I observe it in the notes to Quaritch's edition of the voyages of Americo Vespucci, and elsewhere. It is certain they had not. No Carib dialect has been found anywhere above the isthmus of Panama. The Caribs of Honduras and Belize have been brought there since the conquest.

Anthropology in the United States Seen with French Eyes.

Last spring Dr. Paul Topinard, the well-known editor of *L'Anthropologie*, made a rapid tour over the United States, and on his return promptly gave his readers his scientific "impressions de voyage" under the title "L'Anthropologie aux Etats Unis"

He considers first the domain of physical anthropology, to which he assigns a rather erroneous history. It is totally misleading to say Aitken Meigs (whose name he spells *Miegg*) "continued Morton"; the fact being that he reversed Morton's most important deductions. It is equally erroneous to date the study of the ethnography of the native race of the United States from the organization of the Bureau of Ethnology in 1879. Long before that, the labors of Gallatin had laid a broad foundation, on which many solid superstructures had been erected. More amusing is the reference to the serpent-mound of Ohio as "discovered by Mr. Putnam", which indicates that Professor Topinard had looked more at our collections than our libraries; though he does mention the work of Squier and Davis, assigning its publication, however, a wrong date, 1840, instead of 1848.

M. Topinard writes at considerable length on the palæolithic question in American archæology, and on the origin of the American race. He seems inclined himself to belive that the American race, like Topsy, "just growed" here, and later became more or less modified by immigrations from Asia. He is, therefore, perfectly willing to accept the discoveries of implements in the Trenton gravels as palæolithic, and immediately post-glacial, if not glacial; but considers them far ante-dated by those obtained by Dr. Hilborne T. Cresson from the Columbian gravels near Claymont; "but," he exclaims, "while the glory of this proof remains with Mr. Cresson, it does not diminish that of Dr. Abbott, who remains the Boucher de Perthes of North America!". In the "fight", therefore, over palæoliths, "rejects", and the like, our visiting scientist sides with Messrs. Wilson, Putnam, Wright and Abbot, and affiliates not with the camp of the enemy.

It is a pity that the Professor, who came over to see the Chicago Exposition, departed before the opening of the Anthropological Department; and that he did not remain to the meetings of the American Association at Madison and the Congress of Anthropologists at Chicago. It is likely that he would have materially modified much that he has written, had such been the case.

A Contribution to Peruvian Mythology.

One of the most interesting fragments of the ancient mythology of Peru is that preserved by a native, Joan de Santa Cruz Pachacuti, with reference to the hero-god Tonapa. Though written early, it was first published at Madrid in 1879. The author was more fluent in his native Kechua than in Spanish, and his construction is often awkward. In some paragraphs he inserts the original prayers and invocations without translations, and when he does give these, his knowledge of Spanish was too limited to be accurate.

In a work published some years ago ("American Hero-Myths) I analyzed this myth, and reached the conclusion that it belonged to the cyclus so common among native American tribes which describes the advent of the fair-hued light god, and the benefits which he brings to his people. Last year, without knowledge of my previous study, Sr. S. A. Lafone-Quevedo of the Argentine Republic, published a very thorough examination of the story in the Revista del Museo de la Plata, under the title "El Culto de Tonapa"; and I am glad to say, reached substantially the same conclusions. He also adds full and careful translations of the Kechua prayers and chants in Pachacuti's narrative, having had the advantage of the assistance of Sr. Mossi, cura of a parish among the Kechuas, and thoroughly familiar with their tongue.

He also is inclined to the belief that the myth of the Tonapa, along with many of the rites connected with it, may have been borrowed by the Kechuas from the Aymaras; in which he coincides with what I had expressed. But in his endeavors to trace a linguistic connection of "Tonapa" with the Nahuatl "Tonatiuh", and of the "Con" of the Kechuas, an important divinity, with the "Canob" of the Mayas of Yucatan, he is certainly led astray by mere phonetic resemblances which mean absolutely nothing. There is not the slightest evidence either in language, history or archæology, that the great Peruvian culture of the south either borrowed from, or loaned to, that of Central America. They appear to have been wholly independent centres of civilization.

—Dr. J. Christian Bay has resigned his position at the Missouri Botanical Gardens, St. Louis, Mo., and accepted the position of bacteriologist of the State Board of Health, Ames, Ia.

—Oscar Clute, M. S., LL.D., resigned his position of president of Michigan Agricultural College and Director of Agricultural Experiment Station to take the same position in the Florida Agricultural College Sept. 5, 1893.

IMPROVEMENTS IN THE STORAGE OF ELECTRICITY.

BY F. H. BOWMAN, D. SC., F. R. S. EDIN., M. INST. E. E., AND ASSOC. INSTS., C. E. AND M. E., ETC. BOWDON, ENGLAND.

It is only within a comparatively recent period that electricity has taken a foremost position for lighting, motive power and general use in chemico-metallurgical operations; still the very great advances which have been made and which are continually in progress have rendered it certain that electricity is the agent of the future, and that the part which it will play in the industrial economy of the world will ever be an increasingly useful and advantageous one. The discovery of the principles of the dynamo by Faraday, and its working out into actual practice by a long series of able inventors, have dispensed with the old and cumbersome methods of the generation of electricity by chemical means, and rendered its production a simple and thoroughly reliable process.

Notwithstanding this, however, the energy is essentially a dynamical one, and the continuance of the current is entirely dependent on the continuous motion of the generating machinery; and hence, whenever the machine stops, the current stops with it. More than this, any fluctuation in the regularity of the power supplied to drive the dynamo produces a more than corresponding fluctuation in the quantity and intensity of the current; and hence it it is necessary to have all the parts of the generating machinery duplicated, which increases the expense of the production of the current. Water power can be stored in reservoirs so that the winter's rain may be made available for summer's drought, and a constant flow of water thus obtained. Gas, which is generated intermittently in retorts, can be stored in suitable holders, and delivered out in regulated quantities throughout any given number of hours; and until it was possible also to store electricity the economical use of it was somewhat restricted, or perhaps it would be better to say that the possibility of its application to a larger number of cases and with more perfect regularity was secured by the method of electrical storage.

It had been noticed in certain experiments with primary chemical batteries that if a current from a battery was sent into another cell, the two elements of which were lead plates in an acid solution, a portion of this energy could be stored up in the elements of this cell, so that when the current was cut off from the charging battery and a connection between the plates of the charged battery completed, a current was obtainable, but flowing in an opposite direction from that in which it had entered the charged battery. This charged battery had its efficiency very much increased by being continuously charged and discharged when the currents sent into it were not so strong as to destroy these effects. The difference, therefore, between a primary battery and an accumulator may be simply stated as follows: In the primary battery the two plates are made of different materials, such as zinc and copper or zinc and platinum, and a current is generated by chemical action upon one of these plates, the other remaining unaffected; whereas in the accumulator both plates are of the same material, namely, lead; and neither of them wastes with the action of the current, the current derived, when the connection is made, being entirely due to the chemical action which has been set up in these plates by the current which was sent into them. It was soon found that, by a proper modification of the elements of the accumulator, the capacity to store the energy could be largely increased, and could also be retained for a considerable period of time without loss. Since the days of Ritter, Planté and Faure, to whom we owe the primary discoveries, very great improvements have been made in these accumulators. The early accumulators, like the early dynamos, were very ineffectual machines, very liable to get out of order, and easily destroyed by local action, and they were very irregular in their power to retain the electric energy; but the improvements which have been introduced into them have done away with many of these difficulties, and the most modern accumulators have an efficiency which but a few years ago would have been considered absolutely impossible.

The earliest form of practical accumulator was devised by Planté, and consisted of two thin sheets of lead, which were separated from each other by a piece of flannel of the same size as the plates. These plates were rolled round in a cylindrical form so as to occupy the least possible space, and then placed in a jar or other suitable vessel containing dilute sulphuric acid. The plates were charged by connecting them respectively with the two poles of a dynamo. The current from the dynamo decomposed the acidulated water, and oxygen was accumulated on one of the plates, and thus a store of chemical energy was provided which could be expended in the generation of an electric current when the charging was complete. The oxygen attached itself to the plate by entering into combination with the lead, thus forming a lead oxide, and the action on the other plate was to remove any oxygen which might be accumulated on the surface of that plate in the form of oxide, and reduce it to a pure metallic form. It will thus be seen that the electric current from the dynamo had accomplished work by tearing asunder the atoms of the acidulated water in which the plates of the accumulator were immersed and storing up the oxygen in combination with the material of one of the plates. A chemical strain is thus induced between the two plates, which increases in intensity as long as the charging current is sent into the acccumulator until a certain point is reached, which point is that at which the whole of the available surface of the oxidized plate has been completely changed into the lead oxide. After that the oxygen is given off from the surface of the plate, and no further storage takes place. When the charging current is taken off and the two poles of the accumulator reconnected, the strain tends to equalize itself, a portion of the oxygen from the oxidized plate passing by electrolitic action to the unoxidized plate until complete chemical equilibrium is restored, when the action ceases. When this process is continued for a length of time, which is necessary, in order that an efficient accumulator may be obtained, this alternate oxidizing and deoxidizing causes the surface of the plates to become more porous, or spongey, and thus it presents a larger surface to the oxidizing agent than would otherwise be the case; and at the same time, the surface of the lead being in a more granular or finer state of division, the alternate oxidization and deoxidization takes place with greater ease and rapidity, and thus not only is the quantity of energy which can be stored greater, but the time required for charging and discharging becomes less. This is a most important matter, because it not only enables a smaller number of cells to be used for the storage of a given quantity of electricity, but it also enables that which is drawn out to be obtained at a more rapid rate, since it is found that the power to receive the charging and to give it out are almost proportional.

The formation of this spongey surface on the plates of the accumulator by the alternating action of an electric current extends over a considerable period of time, and is a most expensive process, because it requires a large expenditure of electric energy to extend the spongey surface to any depth in the plates. To get over this difficulty in the more modern forms of the accumulator, devices were employed to obtain this sensitized surface in a more efficient and cheaper manner, such as dipping plates in oxidizing acids so as to chemically prepare the surface, scoring the plates, corrugating them, or giving them star-like or other sections, so as to present a larger surface for the same weight, filling perforated cylinders or other hollow forms with finely divided lead. The greatest advance, however, was made when it was discovered that by punching holes in the plates so as to give them the form of a collander and filling them up with an acid paste of red lead, or, better still, casting the plates in the form of a grid or grate and filling up the holes in the grid with an acid mixture of red lead for the positive plate and lithage, which is a lower oxide of lead, for the negative plate, plates in this form required much less forming and a much shorter time to charge, retained their charge for a longer period and gave out their discharge with greater regularity and in larger volume. This marked a distinct advance in the storage of electricity, and in the various forms of accumulators which are constructed in this manner very reliable and efficient results have been produced.

They have, however, one disadvantage: if they are either charged or discharged too rapidly a disintegration of the surface of the sensitised portions of the plate occurs. It probably arises from this cause. The acid paste of lead oxide consists of a mechanical aggregation of molecules of lead oxide, which are neither perfectly homogeneous in their structure nor perfectly regular in the arrangement of the molecules. The interstices between the molecules, from the very nature of the irregularity in the mechanical structure, must also be irregular. When, therefore, either in the charging or discharging, there is an evolution of gas in the interstices of the sensitised portion of the plate, especially at the surface, the increase in volume by the change of the liquid portion of the electrolite into the gaseous form throws a pressure within the interior of the molecular mass; and, in consequence of the irregularity in the interstices, these gaseous streams conflict with each other, and hence portions of the surface of the plate are disintegrated and fall down into the bottom of the cells. When the current, either in charging or discharging, is small in quantity, this disadvantage does not appear in the same proportion as when the charge or discharge is great. In actual use also it is generally desirable to draw out the stored energy at a greater rate than to charge it, so that the accumulator during the period of charging is usually subjected to a much less strain than during the period of discharge. When, therefore, the charge requires to be drawn out very quickly, the plates suffer rapid deterioration, and this rapid deterioration very soon breaks up the sensitized portions of the plates, and, by causing unequal expansion and contraction, causes buckling and local action.

This is one of the greatest disadvantages which this form of accumulator possesses, and it is this fault which has rendered them, not only in inexperienced hands, very inefficacious, but also very costly to maintain. The most modern form of accumulator to-day has now almost entirely done away with this disadvantage. It is well known that in a crystalline form the molecules of matter are arranged in a different order from what they are in any mechanical mixture. In the mechanical mixture the aggregation of the atoms is strictly fortuitous, that is to say, it is a mere question of chance how they are arranged, and they have no cohesion amongst themselves beyond that which is given to them by the cementing mixture which holds them together. In the crystalline form, however, all this is changed; the molecules of the body are arranged in perfect symmetrical order, and they are held together by molecular affinities which regulate the order of their distribution and secure the coherence of the mass. It is quite true that the material is denser unless some means are employed to modify the density; but although this is the case, the molecular channels which exist in the interstices of the crystal are arranged in as regular order as the molecules of the crystals themselves. This property has recently been employed with very great success in the formation of accumulators, and has enabled the plates of which they are composed to have the greatest uniformity in structure, capacity in storage, rapidity in charging, and regularity in discharging. While all these objects have been obtained, it has been found, in addition, that there is a greater durability in the life of the accumulator and a greater power to retain the intensity of the voltage almost to the end of the discharge.

The active part of the plates is formed of chemically pure lead, which is obtained in the following manner: White chloride of lead, after being thoroughly washed and dried, is mixed with a certain portion of chloride of zinc. The proportion varies with the use to which the accumulators are to be put, as upon this mixture depends the degree of density or porosity of the reduced lead, and this method of manufacture secures a most complete control over the structure of the plates. The mixture of lead and zinc chlorides is then fused together into a molten state, and cast in blocks like small tiles in suitable moulds. The size and thickness of these tiles depend on the purpose to which the accumulators are to be put. The form of the tile also varies with the particular form and size of which the plates of the accumulator are to be made. These chloride squares are then placed in a bath of dilute hydrochloric acid, which removes all the chloride of zinc. They are then dried and placed in suitable moulds to receive the framework of lead into which they are cast. The plates of lead enclosing the tiles of dried lead chloride are then placed in a dilute solution of chloride of zinc along with alternate plates of zinc, and, a connection being made between these plates, an electric couple is obtained. The lead chloride in the tiles is thus reduced to a pure porous metallic lead. If a section is made of one of these chloride tiles which has thus been reduced to pure porous metallic lead, it is found that the direction of the pores is always at right angles to the surface of the plate, and this structure, therefore, enables the electrolite with which the accumulator has been formed to penetrate every portion of the porous lead, and the structure also offers very little resistance to the disengagement of the gas which is formed by the electrolitic decomposition; and thus there is no tendency to disintegration of the plate, because no pressure is thrown upon the molecular structure. In the first formation of these plates those which are intended for cathodes or negatives and those which are intended for anodes or positives are all treated alike; but it is found better to again treat those plates which are intended for positives in a further manner by placing them along with alternate plates of lead in acidulated water and exposing them to the action of a current of electricity which is sent into them from a dynamo. By these means a reduction of the lead is more completely performed, and the greatest efficiency of the accumulator secured. The formed plates can then be built up alternately with the negative plates into any size of accumulator which is required.

The construction of this type of accumulator has solved many of the difficulties hitherto experienced. It has produced an accumulator with every quality which is most desirable, viz., a high rate of charge and discharge without injury to the plate, a high capacity of storage, and the maintenance of the voltage through a very large percentage of the capacity. Along with this there is also a very greatly increased durability; and the fact that the same number of ampere hours can be stored in half the weight of plates as against every other previous system not only makes their introduction a distinct era in electrical science, but opens up an increasingly wide field for their use in every-day life. As accumulators built in this form have been working, notably in Paris, for several years, their durability and efficiency are placed beyond doubt. Not only will they be of the greatest service in connection with electric lighting installations, but their high efficiency and light weight render it probable that sooner or later, in some form or other, they will render electric traction over ordinary roads not only a possibility, but a commercial success. It is probable that along the lines of this discovery still further improvements may be made, and each step in advance will probably open up increasingly wide fields for electrical application.

LETTERS TO THE EDITOR.

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

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

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

THE SYSTEMATIC POSITION OF DIPTERA.

IN connection with the discussion that has been had on this subject in the columns of *Science*, Prof. John B. Smith has suggested that I send you some ideas of my own, as expounded in a lecture before the Brooklyn Institute last February, which was substantially the same as one previously given before the Lowell Institute at Boston, in January, 1892. It was on the general subject of social insects, and after showing that the insects treated were among the more intelligent of the insect world, I concluded with a statement of my own views as to the nature of this intelligence, and urged that we can never properly appreciate or bring ourselves into sympathy with lower creatures until we recognize that they are actuated by the same kind of intelligence as we ourselves. I drew attention to the significant fact that, just as among the mammalia, the higher intellectual development, as in man, is found physiologically correlated with the longest period of dependent infancy, and that this helpless infancy has been, in fact, a prime influence in the origin, through family, clan, tribe and state, of organized civilization; so in the insect world we find the same physiological correlation between the higher intelligence and dependent infancy, and are justified in concluding that the latter is in the same way physiologically correlated with brain development, and, at the same time, the cause of the high organization and division of labor. I then alluded to the discussion as to the systematic position of the different orders of insects, and especially to the claims that had been made for the Diptera as being of the highest rank. I argued that such claims were not justified, and pleaded for the Hymenoptera, not only on some of the grounds indicated by Dr. Packard, but particularly on the ground that the highest degree of intelligence among insects is exhibited by the social species in this order. There is a great deal that is vague and unmeaning in the discussion as to what is "high" or "low" in the relations of organisms to each other. If specialization of external structural parts is to be looked upon as an index of high position, then very many animals must be admitted to outrank man, whose bodily characteristics are in many respects embryological and non-specialized; while the parasitic forms among insects would have to be placed among the very highest, since, in a majority of instances, they exhibit the most perfect adaptations and specializations. Yet these last are almost universally admitted to be degraded forms, while few men will willingly allow that the genus Homo does not stand at the apex of the mammalian class. His superiority, however, is just as uniformly conceded to be by virtue of his intellect.

In the same way I urged that the order Hymenoptera, containing, as it does, the more highly developed social and intelligent insects, should, by virtue of these facts, rank above all other orders. This question of rank is meaningless, except as an indication of relative complexity of structure, the organisms best deserving to be ranked above all others in development being those which have acquired the greatest complexity. Nor must this complexity be confined to mere external structure, but must include nervous organization and brain development—in other words, must include psychical as well as physical characteristics. There is probably no more complex animal organ than the human brain, just as among insects there is probably no more complex hexapod organ than the brain of the ant or of the bee.

Such are substantially the ideas I set forth, the plea being that intelligence should no more be omitted from any discussion of the question of development or rank among insects than among vertebrates.

C. F. RILEY.

Washington, D. C.

BOOK-REVIEWS.

Vagaries of Sanitary Science. By F. L. DIBBLE, M. D. Philadelphia, J. B. Lippincott Company. 462 p., 8 vo.

IMPRESSED with the imperfections, misstatements and inconsistencies of vital statistics in general, and of the reports of boards of health in particular, the author of the above-named work undertook a systematic study of Sanitary Science as practised by its votaries, and from being a believer in the same he has become a bitter antagonist, raising a protest most bitter in tone against all the accepted rulings. The book is outrageous in its sweeping challenge of cleanliness, and the author has certainly laid himself open to criticism in his championship of dirt and filth; but yet there is a certain well defined point of value in that it sounds a note of caution at a time when we are all rushing headlong into an unscientific acceptance of sanitary promulgations. Attention, too, is called to the character of the men who have taken up this branch of work, and, though the general statements are a slur upon the many earnest and scientific workers, still the statements are too often true of the members of many of our city boards.

The origin of the movement is described in the "Introductory" chapter as "a kind of disorderly agitation that suddenly seized the people of Great Britain following an inquiry into the condition and manners of living of the poorer classes of that country." In our own country the origin is ascribed "more to a fondness and habit of imitating the English than to any other cause." The movement is likened to a fanatical religious awakening, and the science to a false religion, whose priests have held whole continents in terror, and who, to gain stability, persistently summon up some new danger to frighten the people, and then caress them into tranquility by the announcement of their discovery of the antidote. The book is recommended by the author—"not for those of life-long prejudice, or who fear to sink into depravity in listening to the innocence of nature's metamorphosis, but for those timid people who have been plagued for the past thirty years by the increasing procession of sanitary terrors, and for those who love truth for truth's sake."

In chapter I, the history of "Sanitarians—Ancient, Mediæval and Modern," is reviewed, and the law-giver of the Jews suffers not less than the modern inspector as he comes under the author's withering sarcasm. The birth of sanitary science in the great sanitary awakening is then described. The next four chapters are devoted to "the tripod on which sanitary science rests"—air, water and soil. The general arrangement of these chapters, as of others throughout the book, is: to first introduce the subject with general remarks; second, to repeat numerous cases where disease has been supposed to originate in filth, then to analyze these cases, expose their feebleness, and, finally, to close with an array of scientific experiments which tend to show that no connection whatever can have existed between this filth and the diseases presumed to have arisen therefrom. Most prominent among these scientists are: Flügge, Pettenkofer, Koch, Miquel, Karlinski, Kraus, Crookes, Tidy, Odling, and Hueppe. Water is attacked through the weakness of the chemical methods in vogue, and also in the fact that typhoid bacilli, etc., according to the testimony of a number of the writers above mentioned, flourish in pure and sterilized water, but quickly disappear in water contaminated with sewage and containing putrefactive bacteria. The same idea is worked out in the discussion of the air and soil. Sewer gas is described as the result of the earlier sanitary measures, and we have it now produced and laid in our houses. The triple alliance the reformers had made with the ladies and clergy was now reinforced by the plumber, who became the "sanitary plumber." Numerous cases are cited in towns, jails, etc., and among workmen employed in the sewers where the sewer gas failed to produce zymotic disease. The sewer gas doctrine is spoken of as "a pure creation, begotten in and floated from the sanitary brain without any investigation, it was, without any examination, accepted and devoutly cherished by almost the entire people, wise and simple, of Great Britain and America—a creation that from the first was viewed with contempt by scientific men of other countries. Pettenkofer said that it was as easy to show that infectious diseases had the same relations to lines of illuminating gas tubes and telegraph wires as to lines of sewers."

Cemeteries, "chronologically the first which the sanitarians erected to affright and torment the people about the health," forms the subject-matter of chapter VIII., with the same discussion as before and the same conclusions. The dangers supposed to lurk in diseased meats and in adulterated and contaminated milk are disposed of in two chapters, and then we have a discussion of filth and fecal diseases, typhoid fever, etc., yellow fever, cholera, and diphtheria. In the case of the first mentioned, typhoid, its parallel development with the sanitary reform is spoken of, the history of the disease is given, and, as before, numerous examples of imperfect identification of the cause. The chapter on cholera containing the testimony of Koch is interesting. A brief history of the world's greatest epidemics is followed by a scorching section on Boards of Health. Dr. Dibble holds "that in so far as they have directed their efforts and consumed their energies on subjects which have no influence on individual or public health, and in so far as they have diverted the attention of the people thereto, just so far have they retarded and obstructed true progress in that branch of medical science which is devoted to hygiene, and just so far they have been a positive detriment to the public health."

Dangerous as the book would undoubtedly be in the popular hand, to the thinking physician it sounds a note of warning, a call for scientific investigation in place of mute acceptance of sanitary rulings, for a superior board of health, and for experimental work. In short, that as hygiene and sanitary science bid fair to play an important, if not the most tmportant, part in our social economy, and to approach with their sister, Medicine, an exact science, that then, with the aid of the biologist, bacteriologist and chemist, these new sciences should rest upon a scientific basis. C. P.

Handbook of Greek and Latin Palaeography. By Edward Maunde Thompson, D. C. L., LL.D., etc. New York., D. Appleton & Co. 1893. 343 p.

This volume of the International Scientific Series is designed especially to facilitate the study of the ancient manuscripts, rather than classical epigraphy, although it does not neglect the development of rustic writing and the majuscules. The first few chapters present a succinct and clear description of the accessories of ancient writing—as the tablets of wax or wood, and the paper, linen, clay, parchment or other surfaces on which it was to be placed; the pens, styles and inks which were employed, and the forms of the books, rolls or codices.

This preliminary matter supplied, the author turns to Greek palæography, explaining first the antiquity of the writing, and the forms of it as shown by various documents. Some of the oldest and most remarkable of these have been obtained at different times from Egypt, and carry us back about two centuries before the Christian era. From this date the characteristics of the Greek uncial and cursive hands are shown, down to a recent period. The remainder of the work is devoted to Latin palæography, from Roman times, through the Lombardic and Merovingian periods and the Middle Ages, and concluding with the Chancery hands, the Charter hands, and the Court hands.

A special feature of the book is the accurate presentation by photogravure of numerous specimens of the hands described, the tables of alphabets, and a useful list of palæographical works.

An Elementary Text-Book of Biology. By J. R. Ainsworth Davis, B. A. Second Edition. London, Chas. Griffin & Co.

The appearance of the second edition of this textbook is indication enough that its plan meets a general want among the people for whom it was designed. The purpose of the present book is to furnish a treatise on theoretical biology, which will serve as a general accompaniment to the various books on practical biology which have appeared from time to time. The author takes up a long series of types, first describing their morphology, then giving a more or less thorough discussion of the physiology of the type, and, lastly, of its development. These three methods of treatment, particularly the last two, make the present text-book one of the most comprehensive text-books in general biology that has appeared in the English language. The morphological part is full and complete, and the descriptions are well illustrated by figures. The sections on physiology and development form the unique feature of this method of teaching, and great praise should be given to the author for putting together in such brief compass the essential principles of theoretical biology. Throughout the book there is that liberal use of italics and full-faced type which aids so materially in making a book intelligible and drawing attention of the student and reader to the important as compared to the unimportant portions of the text. The book is also thoroughly illustrated by figures, most of which are very good and clear, but a few of which are extremely crude and poor. It is hardly possible for one to make much out of the figure describing the anatomy of the pigeon or the frog, and one regrets that the second edition has not seen some of these poor cuts replaced by better ones.

The new edition of the book is entirely rewritten and very much enlarged. So much larger has it been made that it has been found necessary to divide it into two volumes, the first volume discussing the morphology and physiology of plants, and the second volume the morphology and physiology of animals. In addition to various changes and expansions in the text, many new types have been added in the second edition. The most important of these new types are Vaucheria, Selaginella, Gregarina, Taenia, Ascaris, Hirudo, Amphioxus, and chapters upon plant cells and tissues, upon fish, upon geographical distribution, and one chapter devoted to man. In the groups of flowering plants also there have been very many additions, so that the whole new edition is nearly twice as large as the original. Perhaps the most valuable additions that have been made in the new edition have been in the sections upon physiology and development. In nearly every case has the physiology of the types been rewritten and expanded, and this is true also of the sections on development. Several additional sections upon the subject of Cytology, including cell development, fertilization, etc., have been added bodily to the work.

This book on biology is excessively compact, and there is crowded within these two volumes an amount of information and discussion which is certainly beyond that which can be accomplished by classes in our institutions. The book is designed, however, especially for certain phases in English education, and not for education in our schools. It is supposed to be accompanied by laboratory work, and the author has hopes that it does not require the guidance of a teacher, but is in a form by which it can be readily followed without guidance. No laboratory directions are given, however, and the details crowded into the sections on morphology are so numerous that it seems hardly possible to hope that they can be comprehended without a very long course of study under the guidance of competent instructors. As a referenee book, however, one cannot speak too highly of this text-book, and as a treatise in theoretical biology it occupies a place not filled by any other English publication.

An Examination of Weismannism. By GEORGE J. ROMANES. Chicago, Open Court Publishing Company.

ONE is always delighted to receive something new from the pen af Mr. Romanes, for he has demonstrated by many attempts his marvelous power of writing clear English and of taking abstruse subjects and dressing them in the fashion that makes them not only intelligible, but interesting to the ordinary reader. The little book here noted is published in anticipation of the second volume of "Darwin After Darwin," the publication of which we are awaiting. It seems a very surprising thing when one looks through the pages of this book, to find Weismannism discussed without a discussion of the subject of the inheritance of acquired characters, for so thoroughly has the inheritance of acquired characters come to be regarded as a part of Weismannism, that one wonders how the subject can be treated without it. But Mr. Romanes scarcely mentions this subject, reserving it, as he tells us, for discussion in his later book. The present discussion is simply a review of Weismannism as a theory of heredity and of evolution, and not as bearing upon the question of acquired characters. In this little work we are to thank Mr. Romanes especially for three features: First, the clear distinction that he has drawn between the Weismannism theory of heredity and his theory of evolution; second, a logical comparison of the heredity theory of Weismann with others somewhat allied to it, especially that of Galton; and third, for the skilful marshalling of the trenchant criticisms against Weismann's views, which have appeared in the discussions of the last few years, and have led to great changes in Weismann's own opinions. We are also fortunate in having given us a historical view of the gradual growth of the theory as it developed in the mind of its author and of the final abandonment of some of the most essential features of the original view.

No word is needed in regard to the excellence of the English and the plainness of the discussion, for Mr. Romanes' writings always show the most clear logical arrangement. The reader of this work cannot fail to gain a more comprehensive view of the general theory of Weismannism and its relation to biological problems, and will appreciate from this discussion, better than from the writings of Weismannn himself, the significance of the final position adopted by Weismann.

The Life of a Butterfly. By SAMUEL H. SCUDDER. New York, Henry Holt & Co. *Brief Guide to the Common Butterflies of Northern United States aod Canada.* By SAMUEL H. SCUDDER. New York, Henry Holt & Co.

THE object of these two books by our leading student of butterflies in the East is to present certain facts in a familiar way for the use of the student who is as a novice interested in the study of nature. The first book, of 180 small pages, gives a familiar description of the life of our most common and best known butterfly, the so-called milkweed butterfly, presenting, in a familiar and popular style, a description of the animal, of its life-history, and its general relation to its surroundings and to science. The author uses the example, as a basis for a discussion of a few striking scientific laws, most interesting of which will be, to the ordinary reader, the study of the geographical distribution and migration of animals, the subject of mimicry as shown by insects, the subject of the power of vision possessed by insects, and a very clear, satisfactory illustration of certain phases of the general law of natural selection. The general design of the book is excellent, and the style is, on the whole, well adapted to the persons to whom the book will appeal. It is unfortunate that no figures are inserted in the text. A small number of figures are put in at the end of the book, but no reference is made to them in the body of the book, and, consequently, the reader will follow the book through without the proper study of the figures which should go with the text. Perhaps, also, the author has made too free a use of scientific names of species of butterflies to be intelligent to the ordinary reader; but, with these few points of criticism, "The Life of a Butterfly," by Mr. Scudder, is one of the interesting and instructive introductions to nature which our scientists are at the present time endeavoring to put within the reach of the non-scientific reader.

The second book is very different in its nature, and is designed to enable the student of butterflies to determine the names and learn of the habits of all of our common species of butterflies. The author has selected one hundred of the commoner forms for description. The introduction of the book gives a long, careful description of the anatomy of a butterfly; and here, even more, it is to be extremely regretted that no figures are introduced. It is so much easier for the beginner to study specimens by the aid of figures of reference that one must seriously regret the lack of the introduction of explanatory figures in the text which describes the structure and anatomy of a butterfly. The description is followed by a key for determining the species of butterflies, and this key is especially valuable, inasmuch as it not only enables the student to determine the species by the use of the adult butterfly, but also has separate keys for determining species by the use of the caterpillar and of the chrysalis. These two secondary keys will make this little book of very much more value to the novice than any other attempt to accomplish a similar purpose. Something over one hundred pages are devoted to a description of one hundred of our commonest butterflies, including not only a description of the butterfly, caterpillar and chrysalis, but a general account of the eggs, the habits, feeding plants and distribution of the species, giving the student thus a brief but comprehensive account of our knowledge of each different species. An appendix, which is fortunately illustrated by figures, gives directions to the student for collecting, rearing, preserving and studying specimens.

The two books together form a very valuable introduction into the study of New England insect life.

Cholera: Its Causes, Symptoms, Pathology and Treatment. By Robert S. Bartholow, M. D., LL.D. Philadelphia, Lea Bros. & Co.

This little book, of 125 pages, is quite opportune in its publication at the present time, when the civilized world is once more agitated over the subject of cholera, and when we are believing that we have succeeded in so mastering the disease as to make the epidemics of former times impossible. Dr. Bartholow writes from an experience of his own through two epidemics, and his words are therefore more authoritative than they might be from one with no personal experience. The book deals with the history of the disease, with the various epidemics that have invaded Europe and America during the present century, and gives, also, a brief account of cholera in this country. It considers carefully the causes of the disease, and accepts the comma bacillus as the existing cause, though recognizing a large factor in personal predisposition toward the disease. The relation of the disease to drinking water is very satisfactorily shown by study of several epidemics in the world, and the details of their distribution through drinking water. The latter part of the book is more strictly for the use of physicians, being an account of the symptoms and treatment of the disease. A chapter on methods of prevention will, perhaps, from its practical standpoint, be the most valuable to the general reader, inasmuch as it is through preventive remedies, rather than through the treatment of the disease, that we are hoping at the present time to be able to stop the spread of this once dreaded scourge. The book is timely, well written and interesting.

Analytical Keys to the Genera and Species of the Water Algæ and the Desmidicæ of the United States. By Alfred C. Stokes. 1893. 177 pp. 1 pl. 8 vo.

This book has been prepared to serve as a key to the genera and species of Algæ and Desmids described in Rev. Francis Wolle's monographs of the two groups. In the introduction Dr. Stokes puts in a strong plea for artificial keys. He is aware that specialists usually look down upon such aids to a knowledge of their subjects, but he rightly thinks that the keys aid the beginner over the hard places in the new study. While the key can only enable one to find the *name* of an object, this name is what every one must find before he can begin any intelligible discussion concerning it. "The object," he says, "cannot be referred to by speech or in writing until its name is known. What other workers in other parts of the world may have said about it, or done with it, cannot be known until its name is learned, as without the name all indexes are closed in all the books in all the libraries. The name is the clue to further knowledge, its starting point, even the hook upon which further information is to be hung. Whatever advanced scientists may say to the contrary, their first effort—perhaps it is an unconscious one—but their first real effort is to ascertain the name of their new specimen. If it has none, they at once proceed to give it one. All the wild talk about the desirability of learning the name is wrong in principle. The name is, as everyone will cheerfully admit, only of secondary importance when compared with a study of habits or morphology, but it is as essential, since it is, and ever must be, the starting point for further investigations, at least on the part of the amateur." So the author has put much time into the making of these artificial keys, and there is no reason for not thinking that they will serve an excellent purpose in showing the way into the labyrinth of the Algæ and Desmids of the United States. J. F. J.

Human Embryology. By Charles Sedgwick Minot. New York, William Wood & Co. 1892. 815 p.

We are extensive compilers of medical works in this country, but are far behind both England and Germany in biological text-books, This important work, by Professor Charles Sedgwick Minot, of the Harvard University Medical School, is actually the first of its kind which can be compared favorably with many similar works done abroad. It is written both for the student of medicine and of biology, and in the past few months since its appearance has taken its place in both these departments of science as a standard, based upon the higher modern conception of medicine as *applied biology*.

By the labors of Gegenbaur, Turner, Cunningham, the death knell of human anatomy taught *per se* has been sounded. It is safe to predict that not only in the brain, but in the muscles and viscera, all medical teaching of the near future will advance to the long ignored truth that man is not only a vertebrate, but a mammal and a descendant of the primates, and that a thoroughly intelligent conception of the human body can only be gained by comparison. Professor Minot will do much to further this progressive idea in medical instruction in this volume, which might very appropriately be called a text-book of vertebrate embryology. In human embryology we are, of course. limited to material obtained after death or by accident, and, considering these limitations, we are surprised by the vast amount of information which the author has brought together upon strictly human development, in addition to the ample treatment of the general features of development of lower types.

These results of ten years' original research and careful compilation from Kölliker, Hertwig, Balfour, Duval, his and others, are brought together in a volume of nine hundred pages which reflects the greatest credit both upon the author and the publisher. There are five hundred illustrations, many of them entirely original and altogether admirably printed. The work, as a whole, marks a great step forward, because it maintains a high level both in thoroughness and in form of publication, as the two essential elements of a successful work. It is difficult for any one not an embryologist to appreciate the labor represented in these pages. The progress of this branch of science has been so rapid, both in respect to fact and to theory, that in a work covering so much ground it is impossible to keep pace with fact and theory. It is this circumstance which should temper our criticism of some portions of the work which are not quite up to date.

The volume opens, appropriately, with a description of the uterus and a general outline of human development. The history of the ova and spermatozoa follows, concluding with the theories of sex. The author is well known as having early advanced the theory that the mature sexual elements differ in respect to sex, stated broadly, that the ovum is a female and the spermatozoan is a male cell. Now, this theory, with others of a similar character, has broken down under the criticisms of Weismann and researches of Hertwig, and has been generally abandoned; yet the author, while fairly stating other views, decidedly leans toward his own—a position which would be perfectly proper in a memoir, but which is out of place in a student's text-book. It is the occasional outcrop of personal bias in the retention or defence of opinions with which the author's name has been associated, either as an originator or a supporter, which constitutes the most serious, in fact, the only serious, defect in this work. Other defects are of minor importance, or unavoidably spring from the immensely wide field covered. The writer of a text-book should ruthlessly sacrifice his most cherished theories if they do not accord with the latest research.

The next section is devoted to the three germ layers of the developing ovum, leading us to the embryo in the third section and the fœtal membranes in the fourth. Through all these pages the author sustains his plan of maintaining a critical attitude, and, as far as possible, verifying his statements by his own observation. Each mammalian structure is introduced by a brief and clear statement of its mode of appearance in the fishes, amphibians and reptiles, rendering these chapters as valuable to the general as to the special student. Duval, in his recent monograph on the placenta of the Rodentia, speaks in high terms of Professor Minot's work upon the placenta, but differs with him in regard to the so-called ecto-placenta, holding that he has mistaken the ecto-placental columns and tubes for the uterine glands.

The latter half of the work is given to the general development of the fœtus and the organology or special development of each of the systems and organs of the body. Here, again, the accuracy and breadth of treatment. The pages simply bristle with information upon every subject treated, giving a thoroughly encyclopædic character. The chapter upon the development of the brain alone is the most complete which has yet appeared, and is thoroughly up to date. One minor protest must be entered here, that is against the use of the Anglicized German term "aulages" for the beginnings of structures. As pointed out by Hurst, Parker and others, we have already an excellent term in the English "rudiment." A "rudimental structure" is, properly speaking, an incipient structure, although often improperly used to designate a disappearing or "vestigial" structure.

The bibliography is very complete. The author shows the utmost readiness to give full acknowledgment to his authorities, and appreciates the importance of acquainting the student with the literature at every step. We know of no other work so full of references. Yet there is a matter which certainly should be remedied in a future edition of the work—the titles are referred to by volume numbers and pages, and not by date; this omission renders it very difficult to keep in mind the historic development of the subject. It is safe to say that four out of five persons in this country who will use this book will not be able to consult periodical files for the date.

In conclusion, we would repeat our high opinions of this work. It is certain to find its way into every medical and biological laboratory in the country, carrying with it the author's spirit of thoroughness in investigation and breadth of view in treatment, and cannot fail to exert a widespread influence upon American embryological research.

NOTES AND NEWS.

The Congress of Evolutionists held the last week in September, in Memorial Art Palace Chicago, was a decided success and in every way a most satisfactory series of meetings. The Congress extended through three days—three sessions each day. The hall assigned to this Congress was well filled during all the sessions and crowded during some of them. After the opening address by B. F. Underwood, the Chairman, in which was sketched the progress of evolutionary thought, a paper on "Social Evolution and Social Duty," contributed by Herbert Spencer, was read, after which Edward P. Powell gave an address on "Constructive Evolution." During the Congress questions in "Biology" were treated by Dr. M. L. Holbrook, Dr. Edmund Montgomery and Rev. John C. Kimball. Edwin Hayden, Dr. Duren J. H. Ward, Mrs. Sara A. Underwood, Prof. T. J. Burrill, and Miss Mary Proctor (daughter of the great astronomer) paid tributes to "The Heroes of Evolution." Psychology as related to Evolution was the subject of addresses by B. F. Underwood, Dr. Herman Gasser, Dr. John E. Purdon and Harvey C. Alford. Sociology was considered by Rev. A. N. Somers, Bayard Holmes, M. D., Mrs. Florence Griswold Buckstaff and Miss Mary A. Dodge ("Gail Hamilton"). "Religion as Affected by Evolution" was the subject of papers and addresses by Dr. Charles T. Stockwell. Rabbi Emil G. Hirsch, Rev. Howard MacQueary, E. P. Powell and others. Rev. M. J. Savage, Dr. Lewis G. Janes, C. Staniland Wake, Revs. Jenckin L. Jones and H. M. Simmons presented papers on "The Morals of Evolution." "Economics as Related to Evolution" was considered by James A. Skilton and others. An interesting feature was a symposium on this subject in the form of brief papers from Mr. John Fiske, Dr. Edmund Montgomery, Dr. R. W. Shufeldt, Benj. B. Kingsbury, F. M. Holland and others. There was not a note of discord during the entire Congress. A committee was appointed at a special meeting held last Sunday evening to arrange for another Evolution Congress in 1894.

—Those who are familiar with the volumes of Appleton's "International Education Series" will remember among them two on "The Mind of the Child," by W. Preyer, professor of physiology in the University of Jena; and the same author has now issued a smaller book on the same subject entitled "Mental Development in the Child," which has been translated into English by H. W. Brown, and published in the same series. The work is designed especially as an aid to mothers in training their young children; but we confess that we cannot see what mothers are to gain from it. It contains, to be sure, many sensible observations; but they are mostly commonplace, while on the other hand the book is full of doubtful physiological speculations expressed in technical language. Take, for instance, the following remarks about self-consciousness: "There are several grades of consciousness, lower and higher, which have different seats—in the higher animals, particularly in the spinal marrow, cervical marrow, and brain. The highest grade, self-consciousness, so-called, which does not necessarily imply a strong self-esteem, has its seat in the gray substance of the cerebral cortex. It is therefore properly called the cortical *ego.*" (p. 155). There is much more in the book of a similar sort; yet the reader must not think that there is nothing better. Professor Preyer has evidently been a close observer of very young children, and is familiar with their wants and ways; and he gives a fairly intelligible outline of their mental growth during the first three years of their lives. His remarks on the acquisition of language and on the manifestations of thought and reasoning before language is acquired are perhaps the best things in the book and are well worthy of attention from students of psychology. But the book cannot be accepted as a satisfactory treatise on the subject with which it deals.

—W. F. Yocum, A. M., D. D., accepted the position of Vice President and Professor of Philosophy and Political Economy in Florida Agricultural College, Oct. 1, 1893.

—Miss Mary Proctor, daughter of the late Richard A. Proctor, is delivering courses of lectures on astronomy to children, under the management of Major J. B. Pond, Everett House, New York.

—The Eleventh Congress of the American Ornithologists' Union will convene in Cambridge, Mass., on Tuesday, November 21, 1893, at eleven o'clock A. M. The meetings will be held in the Nash Lecture-room, University Museum, Oxford street. The reading of papers will form a prominent feature of the meetings. Associate as well as Active members are earnestly requested to contribute. Titles of communications and applications for membership should be sent to the Secretary, Mr. John H. Sage, Portland, Connecticut.

SOME OF THE NEW BOOKS.

JARED SPARKS.—$5.

In no department is American literature confessedly stronger than in history. The names of Bancroft, Prescott, Motley and Parkman—to mention no others—are enough to show that the United States have a creditable standing not only in making history but also in recording it. Among the names of our noted historians that of Jared Sparks is not always mentioned, but he was the forerunner of the modern school of investigators who go to the original sources and write at first-hand. He made extensive journeys in the Southern States in search of documents in which the story of the Revolution was told by the actors in it; he went to Europe several times to labor in the English State Paper Office, and in the French public record offices; wherever he learned that letters or journals of Washington or Franklin or their great associates were to be found, there he bent his assiduous way and spent laborious days, copying or extracting. Professor Adams, who is thoroughly qualified from his work as a professor of history to do justice to Sparks, thus states his claims to grateful remembrance by Americans:

"It is, then, as an original investigator, as a pioneer in American history, that Jared Sparks will chiefly interest the present generation. Nobody knew better than he under what limitations original and pioneer work is always done. His labors were chiefly *bahnbrechend*, or path-finding, in the vast wilderness of American history. He first opened roads along which modern students are now easily and swiftly passing, too often without a grateful thought for the original explorer."

Professor Adams has executed a difficult task in an exemplary manner; his biography is well proportioned and well adapted to the purpose of a limited edition intended mainly for libraries and special students.—*Boston Literary World.*

A JAPANESE INTERIOR.—

The title, "A Japanese Ir[illegible] may be said to have a moral[illegible] than a material application, for while we are shown, sometimes with much graphic detail, the inner arrangements of a Japanese house, it is rather with the peculiarities of Japanese custom and the points of view incident to Japanese life that the volume before us has to do.

The letters which make up Miss Bacon's book were written during a residence in Tokyo as teacher in one of the schools for noble girls under the management of the Imperial Household Department. They are intimate in character, being chronicles of events and impressions imparted in a friendly and gossipy fashion to relatives at home, and having throughout that conversational atmosphere which, while wholly destructive of what is called "style," is a charming medium through which to view pictures of every-day life and character. The author frankly confesses that they resemble the product of a photographic camera rather than that of an artist's brush, and, having so said, she puts us quite at our ease and carries us along through her experiences in housekeeping, shopping and engaging of cooks, in jinrikisha riding and eating and church-going until we fairly forget our Occidental surroundings and begin to look about for a paper, parasol and a folding fan.

At the beginning of Miss Bacon's career she seems to have suffered much from the fact that her Anclicized Japanese was about as imperfect as the Japanicized English of those about her. Time, however, meliorated this difficulty, and her comfort increased as the comedy of the situation lessened.

Not the least engaging of the subjects touched upon are the references to Japanese dress, festival and mourning costumes, and in some detailed descriptions, such as that of Yasaku's wedding and the Feast of Dolls at a Daimio's Yashiki, we have narratives of unusual interest. The volume is [illegible]nt, chatty and withal instructive [illegible]uch matters as a stay-at-home [illegible]nes to understand.—*Philadulphia [B]ulletin.*

SCIENCE

ELEVENTH YEAR.
VOL. XXII. No. 563.

NOVEMBER 17, 1893.

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QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, NOVEMBER 17, 1893.

LETTERS TO THE EDITOR.

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

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

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

(For other letters see page 276.)

POSTAGE ON NATURAL HISTORY SPECIMENS.

It has always been recognized that scientific research is greatly furthered by the exchange of the various objects with which that research is concerned. For the transmission of objects of Natural History from one country to another, the mails have offered a cheap, speedy and reliable means. Heretofore, through the laxity with which the regulations on the subject have been enforced, it has been possible to enter such objects in the mails of the Universal Postal Union as samples of merchandise and under the rates of postage therefor. From official information lately received from the Post Office Department of the United States it appears that such a rating is entirely unauthorized by existing provisions, and that objects of Natural History may be mailed to countries of the Union only at the rates required for letters. The United States Post Office Department also stated that it had recently submitted a proposition to the countries composing the Postal Union, to modify the regulations so that such specimens might be received into the mails at the same rates as samples of merchandise, but that a sufficient number of those countries had voted against the proposition to defeat it.

This Academy has therefore resolved to address the various scientific bodies, with which it is in communication in those countries whose governments have voted against the proposition, and to request those scientific bodies to memorialize their respective governments in favor of the same.

The Governments of Austria, Bolivia, British India Canada, Germany, Great Britain, Guatemela' Hungary Japan, Norway, Portugal, Russia, Spain, Sweden, Tunis, Uruguay and Venezuela having voted in the negative, this Academy respectfully requests the favorable consideration of this question by scientific societies, and begs that they take such steps as they deem advisable to inform the postal authorities of their respective governments of the manifest advantages to scientific research which would result from the adoption of the proposed modification, and to request those authorities to take such steps as may result in the adoption of the same.

The letter rate for postage (Universal Postal Union) is ten times that required for samples of merchandise; such a rate for specimens of Natural History is virtually prohibitive.

This Academy would respectfully urge upon scientific societies prompt action on this matter if it meets with that approval which we so strongly desire.

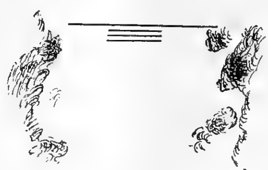
ISAAC J. WISTAR, President.
EDW. J. NOLAN, Recording Secretary.

The Academy of Natural Sciences of Philadelphia, November 14.

THE PICTURE IN THE LANDSCAPE.

The inquiry by Waldo Dennis, on page 213, into the causes of the unlike impressions which one receives from a given landscape and from a painting of it, seems to me to explain the subject admirably. He supposes that the reason why the picture appeals to us more than the landscape does is because the picture is condensed and the mind becomes acquainted with its entire purpose at once, while the landscape is so broad that the individual objects at first fix the attention, and it is only by a process of synthesis that the unity of the landscape finally becomes apparent. This is admirably illustrated in photographs. One of the first surprises which I experienced when I began the use of the camera was the discovery that very tame scenes become interesting and often even spirited in the photograph. But there is something more than mere condensation in this vitalizing and beautifying effect of the photograph or the painting. Individual objects are so much reduced that they no longer appeal to us as distinct subjects, and however uncouth they may be in the reality, they make no impression in the picture. The thin and sere sward may appear rather like a closely shaven lawn or a new-mown meadow. And again, the picture sets a limit to the scene, it frames it, and thereby cuts off all extraneous and confusing or irrelevant landscapes.

All these remarks are enforced in the æsthetics of landscape-gardening. It is the artist's one desire to make pictures in the landscape. This is done in two ways—by the form of plantations and by the use of vistas. He will throw his plantations into such positions that open and yet more or less confined areas of greensward are presented to the observer at various points. This glade-like opening is nearly or quite devoid of small or individual



objects, which always destroy the unity of such areas and are meaningless in themselves. The two sketches illustrate my meaning. The upper one is a fair diagram of the average front-yard. It is full of individual trees and bushes, or groups, and the eye is carried from object to object, while the entire yard makes no quick appeal to the mind. One is pleased only with the kinds of plants which he sees. The lower sketch presents a definite area at once to the observer, and the individual plants are of minor importance. Here is a landscape —a picture; there was a nursery.

A vista is a narrow opening or view between plantations to a distant landscape. It cuts up the broad horizon into portions which are readily cognizable. It frames portions of the country-side. The verdurous sides of the planting are the sides of the frame; the foreground is the bottom and the sky is the top. L. H. Bailey.

Ithaca, N. Y.

The Original Type of Corn.

Referring to the article by Mr. Hershey in a recent number of *Science*, there are six types of corn, viz.: dent corn, flint corn, pop corn, sweet corn, soft corn and pod corn. Each of the first five has well marked structural differences in the kernel. Dr. Sturtevant proposed to distinguish these differences by calling these types agricultural species. The kernel of the pod corn does not present structural differences markedly unlike that of the flint corn, and probably under proper conditions would take on the characters of dent corn, but this type differs from all the others in that each kernel has a husk of its own, besides the usual husk that covers the ear; hence the name pod corn.

It has been claimed that this type of corn has been found growing wild in the Rocky Mountains and one observer reports it from Brazil. Just how authentic these observations are I do not know. I have some doubts about them, but be that as it may, this type has a special interest to Mr. Hershey in that it is quite customary for it to have fairly well-formed ears in the tassel, each kernel being covered with husks, and the whole ear more or less covered with a husk, although the outer husk is generally rather slight for reasons which will appear later on.

The transition from corn bearing its seeds in the tassel to that having ears at the joints is not hard to imagine, when we recognize that each joint has a tendency to produce an ear or throw out a sucker. Suckers, that is, stalks of smaller size than the main stalks and frequently barren, result from the lower joints of the main stalk, and ears from the upper ones when anything develops from these joints.

Now if we assume it likely that originally each joint threw out a sucker, which at that time would be a stalk bearing at its top both staminate and pistillate flowers, it is not difficult to see that these suckers might easily be modified into ears, that is, stalks bearing only pistillate flowers. Obviously, in the process of natural selection, those plants would be most likely to survive which had the most pollen in the upper tassel, or, in other words, in the tassel of the main stalk, because the pollen tends to descend. On the other hand, the ovaries on tassels lower down on the suckers would be more likely to be fertilized by virtue of their position. It would thus come about that there would be less and less ovaries produced on the upper tassel and less pollen on the lower ones, until we had only pistillate flowers below and staminate ones above.

There are varieties to-day, such as Blount's Prolific, which have six to eight ears upon a stalk; but these varieties are almost uniformly inferior to those varieties with but one ear per stalk for the production of grain. We can readily understand, therefore, that man in semi-civilized times early recognized that, for the production of grain, the only part of the plant then used, those plants with the fewer ears were superior, and hence selected such until the one-eared varieties resulted.

All varieties tend to sucker, more or less, when planted thinly; that is, to produce more stalks than there were seeds planted. The supernumerary stalks come from the joints at the base of the main plant. If you plant four kernels of Brazillian flour-corn, a variety belonging to the soft corn type, you will get, under normal conditions, about twelve stalks of corn. About three joints of each main plant produce stalks or suckers. While suckers frequently produce ears, they have a tendency to be barren, and they are more prone than the main stalks to produce corn in the tassel, although the production of corn in the tassel is more common generally than Mr. Hershey evidently supposes.

All ears are borne at the end of stalks, much more reduced in length than those we commonly call suckers. Yet the length of these stalks varies greatly in different varieties, and practical men prefer, other things equal, the ear with the shorter stalk or shank. Of course, in early times those plants having the grain on the shorter stalks would be selected, both because the stalk would be of no possible advantage and because the shorter the stalks the more completely the ear would be covered with husk, due to the fact that the husks are but slightly modified leaves. Indeed, this may have come about from natural selection, if corn ever in this form grew in a state of nature, due to the fact that the husk is a protection from its natural enemies, and hence the more husk on the ear the less would be the liability of the seeds being destroyed, hence the greater likelihood of such plants being perpetuated. Thomas F. Hunt.

Ohio State University.

—Immediately following the World's Congress on Horticulture at Chicago in August last, a series of meetings was held to consider the advisability of organizing a horticultural society which shall include every country of the globe. After much discussion, in which many eminent men from various parts of the world engaged, the World's Horticultural Society was organized and the election of the three general officers was held on the 25th of August. This new society is designed, in the language of the constitution, "to promote correspondence and to facilitate exchange of plants and information between the countries of the world. This society can coördinate and extend the work of all existing societies, compile statistics, promote legislation and education, prepare correspondence directories, diffuse all the latest information from the various parts of the globe, consider means of transportation and facilitate the exchange of varieties and every commodity in which pomologists, viticulturists, florists, vegetable gardeners and other horticulturists are interested. The society will probably meet occasionally at the various International Exhibitions, upon which occasions, also, it can greatly aid in procuring exhibits from all parts of the world. The Society now requests the earnest and early support of its friends. The Vice Presidents of the various countries will be announced soon, and the organization will then be quickly completed. The Society needs the co-operation of every enlightened horticulturist and every important horticultural organization. Prosper J. Berckmans, President, Augusta, Georgia, U. S. A.; Henri L. DeVilmorin, Vice President, No. 22 Avenue de la Bourbonnais, Paris, France; L. H. Bailey, Ithaca, N. Y., U. S. A., Secretary-Treasurer for the United States, and temporary Secretary-Treasurer at Large.

—The American Academy of Arts and Sciences, at a meeting held in Boston on Nov. 8, voted to grant—from the C. M. Warren Fund for Encouraging Chemical Research—the sum of $300 to Professor C. F. Mabery, of Cleveland, Ohio, in aid of his investigations on the American sulphur petroleums.

—Another of Robert S. Ball's popular books on Astronomy, entitled, "In the High Heavens," is to be published soon by J. B. Lippincott Company. It will be profusely illustrated by drawings in the text and a number of full-page colored plates.

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

RECENT DISCOVERIES IN NORTHEASTERN NICARAGUA: GRANITE HILLS, MOUTONNÉD RIDGES AND GOLD-CONTAINING LODES OR REEFS, AND LEADS OR PLACER MINES.

BY J. CRAWFORD, RIO WANQUE OR COCO, AT SAN RAMON, NICARAGUA.

DURING the past year, commencing August, 1892, ten months of nearly continuous exploration have been spent by the author over an area of some 10,000 to 12,000 square miles in the uninhabited wilderness and jungle that cover a large part of northeastern Nicaragua, examining the geology, minerology, and flora existing in great attractiveness and variety in that part of the country. Among the numerous interesting features and peculiarities discovered or noted that are worthy, from both a scientific and economical point of view, of a more special description than was given of them in my paper, "Hydrographic Area of the Rio Waukey, or Coco-Nicaragua," published in *Science*, in April, 1893, are the following:

(a) The granite outbursts exposed on the tops of oval-shaped *Cerros* or mountains, and which also form the *Cima del Cerro* and longer axis of long, high, mountain ridges.

(b) The numerous moutonnéd ridges and lateral and terminal moraines, in series that evidence the former existence of a glacial epoch which covered an area of several thousand square miles in Nicaragua with a flow of glacial ice.

(c) The erosion-sculptured *Cerros* that intervene between the granite hills and moutonnéd ridges, composed of debris denuded from both the nearby granite mountains and materials from mountain ranges found further to the southward.

(d) The reefs or lodes (many of them auriferous) and dykes (of diorite) in which auriferous quartz veins are discovered piercing the mountains and ridges parallel to the length of the series of the system; and also the Post-Pliocene leads of drifts of gravels and boulders. Gold is found exposed in the banks at sides of streams, that appear to extend through the erosion-sculptured hills near their base, and also the alluvial leads, drifts of gravels, gold, etc., found in the channels of the creeks and in strata in the lower parts of valleys.

(e) The composition and fertility or non-fertility of the soil and its fitness, in places, for the vigorous growth of certain kinds of trees or plants, also the peculiar formation where groves of some kinds of valuable trees were found growing to large dimensions.

(f) The apparent geological history of the granite hills, dykes, reefs or lodes, moutonnéd ridges, erosion-formed ridges, and of the leads or placer mines.

The region in northeastern Nicaragua chosen for description in this paper as typical of a few others in that part of the country is a wilderness unoccupied by man[1]; and although this locality is a part of Nicaragua, neither the government nor the citizens of that country have even a vague conception of its importance and its truly great undeveloped wealth in valuable minerals and metals, timber, and agricultural lands. The centre of this chosen locality is about longitude 85° W. (from Greenwich) and latitude 14° N., and embraces the headwaters of Nawawass, Wilson, Loccus, Umbra, Waspoopoo, Moorawass, Sangsang and Daka Creeks, and Wasspook River, confluents to Rio Waukey, or Coco River, and also the line of *Cerros*, about sixty miles long, just south of the Wasspook River.

The granite masses appear to be in two parallel lines of elevation, but connected together as one mass and composed of rock of the same mineral composition, usually amphibole, syenites (with and without quartz), and also protogene and plagioclose varieties appear most numerous. The cooling has permitted the crystallization of the minerals so similarly at about the same depth from the surface (isogeothermal zone) in each line of ridges, as to indicate that the two exposed lines were of the same mass and lowering in temperature at the same rate. The granite has been exposed by erosion, and the hills, also, have been eroded deeply at many places, and the rocks have, at several places observed, become disintegrated and decomposed, *in situ*, to depths of five to twenty feet. The exposed granites are in series of spurs and ridges that extend northeastwardly for about ninety miles from the Barbar Mountains (at the southeastern termination of the Matagalpa system of mountains), and form an angle of about 120° with the southeasterly and northwesterly direction of that mountain system, which is composed largely of Archean and Silurian era rocks.

The northeastern termination of these granite spurs and ridges is near to the confluence of the Rios Wasspook and Wauque, at a distance of about one hundred miles west from the Carribbean Sea, on the eastern coast of Nicaragua, and about the same distance south from that sea on the northern coast of Nicaragua. The forces causing this upheaval of granite appear also to have fissured the superimposed and adjacent systems of rocks for many miles[2]. These fissures are now filled by deposition of minerals and metals from hot solutions, and are now reefs or lodes, containing quartz, gold, metallic ores, and other minerals. Near the northern termination of these granite ridges were found patches, of varying size, of auriferous sands, gravels, clays, and boulders—detritus transported by water from the denuded granite hills and from ranges in the Matagalpa system of mountains. These deposits of detritus increase in size northwardly, until covered northwardly by the sands and mud composing the delta of the Rio Wauque; and on the west the deposits of detritus were in large quantities, and subsequently have been sculptured by erosion into hills and ridges; also found resting in small areas on the granite ridges are boulders in size from a few pounds to over two hundred pounds each, of varieties of bluish glaucophanyte, or hypers-

[1]Recently two or three Latin-Americans have, in a crude way, simulated placer-mining work in one or two of the mineral localities. They appear hopeful and cheerful.

[2]It is very difficult, frequently impossible, to trace the extent of the outcropping of lodes or reefs, and even of dykes, in this wilderness of dense growth of trees, vines and plants and a deep soil.

thenyte, or augyte, or trachyte rocks, that appear thickly sprinkled with pyrites and magnetic and titanic iron ores; these boulders were weathered toward their centres from one to three inches, and were found to be auriferous—in some instances, highly so; they differ in composition and color from the hornblende and orthoclase granite-mass forming the axis and serrated ridges of the hills, also from the boulders mixed with the patches of clay, sands, gravels, and boulders that are found to the southward on these granite hills and ridges. This filling up of former existing valleys with the materials worn off, in part, from the granite ridges, evidences a subsidence in that locality at the time, and this evidence is supported by the existence, to the north of the granite hills and between them and the Wauque, or Coco, River, of a disconnected line of limestone; on one depression of this limestone a deposit of the auriferous clays, sands, gravels, and boulders was found. The eroding into hills and valleys, as they at present appear, composed of the mass of detritus of disintegrated granites, etc., is evidence of a subsequent elevation of that entire region and the completing of one oscillation of subsidence and of re-elevation there.

The moutonnéd ridges extend for about sixty miles in a series of parallel oblong ridges northeastwardly from near the base of the tall Barbar and Peña Blanca Mountains, that at present have an altitude of over 7,000 feet above the Caribbean Sea. One of the projecting lines of moraines extends further northward, and is about ninety miles long until it terminates at a dyke, on whose sides auriferous gravels are found, in which the Rio Wauque has cut its channel at San Ramon.

This system of moutonnéd ridges extends to a width eastward and westward of about twenty-five miles, and has at present an altitude above the creeks at its base of from 70 to 400 feet. They were found to be composed most generally of unstratified clays, sands, gravels, and boulders; occasionally, however, these materials are partly stratified and partly assorted. The enclosed boulders are of various sizes, from ten pounds to several tons weight, and are usually angular or sub-angular, becoming oblong and oval as the series of moutonnéd ridges extend northward, *i. e.*, towards the Wauque River, and are composed most generally of fragments of auriferous quartz, granites, syenites, hornblendic feldspatic rocks.

These moutonnéd ridges have been denuded and eroded by the very energetic and potent meteorological forces in this locality, until numerous large boulders have been displaced and lie on the sides and at the base of the ridges; also numerous gulleys score deeply the sides of these ridges, and deep ravines or channels of the flowing creeks separate many of them from each other. These moutonnéd ridges are unquestionable evidences of a glacial epoch and of a long-continued glacial flow *at this low parallel*—only 14° north from the equator[3]—which covered quite a large part of the present existing narrow divide of land (containing about 48,000 square miles) between the Pacific Ocean and the Caribbean Sea. Adjoining the granite hills on the northward and northwestward, often between the moutonnéd and the granite ridges, are a number of erosion-sculptured hills that have been carved out by the draining forces attending the elevation of lands in that locality, and evidence that elevation, and subsequently by meteoric forces. These hills of erosion are composed of the detritus of rocks transported by water from the southeastern ending of the Matagalpa system of mountains (a distance of seventy to eighty miles southwest), and of materials eroded from the adjoining and nearby series of granite hills; the materials composing them have been cemented and concreted into semi-hard rocks and conglomerate masses of clastic rocks. The altitude above the Caribbean Sea of many of these granite ridges, erosion-formed *Cerros* and moutonnéd ridges, is from 1,000 to 3,500 feet; all are covered with a dense growth of large trees, or, in some places on the erosion-formed ridges, covered with a jungle of trees, bamboos, vines, and other vegetation.

The reefs, or lodes, strike east of north and west of south, parallel to the long axis of the ridges and mountains, and those discovered usually dip at an angle of about 120° south. They are from 6 to 30 inches wide, and usually appear to be rich in gold and in metallic sulphides and arsenides. The reefs at the granite ridges are parallel with those ridges, and found at the contact between the granite and superimposed rocks (though some appear to be in the granite) as principal lodes, from which extend at various angles into the adjacent erosion-carved *Cerros* many fissures containing the oxide of metals, gold, sulphides, etc. Some few of these fissures appear to continue northwardly into the moutonnéd ridges; but this was not verified, because of the deep soil and dense undergrowth that covers the surface of the hills and valleys at that locality. The reefs parallel with the granite ridges extend southwestwardly to near the Barbar Mountains, where they appear to form an obtuse angle with the auriferous reefs, or lodes, that extend (southeast and northwest across Nicaragua) along the foothills of the Matagalpa system of mountains, from the Caribbean Sea to the Pacific Ocean. In the granite hills were discovered two large deposits of iron ores, limonite and hematite, and one deposit of manganese ore, the black di-oxide pyrolusite; also graphite and some tin sulphide, stannite, whether in paying quantities or not, *i. e.*, profitable to mining, has not been determined satisfactorily, because they were found but recently, this year, 1893, in an uninhabited wilderness; they are, however, in a thoroughly mineralized locality. The auriferous reefs are of the Dioritic gold-evolved era (as classified by David Forbes, F. R. S., in his paper "On the Geological Epoch at Which Gold Has Made Its Appearance in the Crust of the earth"),[4] and appear at the surface often where many greenstone rocks were discovered.

The auriferous placer deposits or leads of clays, gravels, sands, gold, and boulders are of different geological epochs, viz.: the strata of partly-cemented auriferous drifts of sands, gravels, etc., exposed in patches, small to several acres, at the sides near the base of the erosion-formed hills and appearing to pass through those hills, and also found in the upper valleys at varying depths beneath the surface and at many places exposed in the banks along the sides of the creeks. These leads of gravel drifts are from 8 to 20 inches thick, and although few masses of gold visible to the unaided eye were observed in them, yet when they had been washed out from a pan there were frequently left in the pan particles, grains, and small nodules of gold, or occasionally laminated small masses of gold of angular, sub-angular, and oval forms. These are "alluvial drifts," or gravel beds, formed during the latter part, I am inclined to believe, of the Champlain epoch, and usually contain only a small per cent of sub-angular and partly rounded quartz. The gold found in them is in rather coarse grains and particles, as described, and evidently derived from three sources:

(a) The auriferous reefs that traverse that part of the country, and—

(b) From the deeply disintegrated granite masses, and—

(c) From the disrupted masses of quartz, pyrites, etc.,

[3]At latitude 12° 20' north from the equator similar moutonned ridges and glacial epoch moraines were discovered on the south side of the southeastern termination of the Matagalpa system of mountain ranges, and were examined by the author of this paper in 1890, and reported on to the British Association for the Advancement of Science, the American Association for the Advancement of Science, and officially to the Government of Nicaragua.

[4]See London Geological Magazine, III., p. 385—7.

that once were enclosed in the moutonnéd ridges, and subsequently eroded therefrom. The gold is believed to be in quantity sufficient to be profitable to mining operations, especially because the mining could be done economically by water, which is convenient, abundant, and has a rapid fall or descent in the nearby creeks.

The alluvial beds of auriferous clays, sands, gravels, and small boulders that are found in the beds of some of the gulches and in the channels of some of the present system of creeks are often partly cemented by hydrous oxide of iron in some places and by silica at other localities. These deposits were commenced, I am persuaded, during the Terrace epoch, and, in some places, are apparently quite rich in gold of rough, semi-angular pieces and in rounded particles; yet some of the particles of gold in the small creeks or nearby dry gulches appear so angular and undisturbed at their edges as to impress one with the opinion that they have increased in size, "grown," where they are discovered by additions from passing solutions containing gold; the chief sources, however, of the gold found in these creeks are the same as those named under the head of reefs or lodes, with additions of gold from the older leads above described found in the upper, and apparently passing through the erosion-formed hills and from accretions of gold deposited from passing auriferous solutions. The bedrock in some of the creeks is an iron-cemented arenaceous argillyte resting on a bed of partly cemented boulders, sands and clays which appear, at one place discovered, probably in the entire locality, to rest on strata of auriferous conglomerates or breccia and this on an auriferous gravel superimposed on a bedrock of metamorphosed shale or slate.

Geological history. We found several obstacles intervening to prevent, at present, that careful examination necessary to determine the geological epoch, when these granite ridges were upheaved and when thereafter they were exposed by the denudation of superimposed strata; during what epoch the regional elevation occurred and the erosion-sculptured hills in that region were formed; from what rocks or sources came the gold found now in the reefs or lodes traversing, longitudinally, the mountains and ridges.

One obstacle is that no ravines or cañons were discovered that deeply enough expose the strata toward the centre of the mountains or ridges.

Other obstacles are, the very deep disintegration, in situ, of the exposed rocks and the deep soil covering the surface and also the dense vegetation, frequently a jungle difficult to cut a pathway through, covering in matted masses even the nearly perpendicular sides of ravines; but, tentatively, and from the clearest examinations we could make, we form the following geological history of this locality.

1. The granite in the hills and ridges was forced up through Jurassic period and later rocks and it upturned to nearly vertical the superimposed strata, in some of which strata were discovered moulds of silica (lined with small crystals of quartz) like the Trigonia Conradi, also others like moulds of Tancredia Warreniana.

The fissures, also the dykes of diorite, appear to have resulted from disturbances occurring in epochs Post-Oolitic, but not extending later than the Cretaceous, this being the latest known or generally recognized time or period during which gold has been conveyed in large quantities or percentages, as a constituent in granites and diorites, up to the earth's crust; these auriferous granites and diorites are certainly abundant in this region and are not Palæozoic nor Cenozoic rocks. The gold in the reefs or lodes has been dissolved from the granites and diorite rocks by hot mineralized waters and deposited therefrom into the fissures or reefs, on cooling or on deoxidation of the solutions, either enclosed in pyrites or as free gold.

The gold in the placer mines, drifts or leads, appears to have been derived almost entirely from the disintegrated and denuded granites forming the mountains and from the reefs in the mountains; a small percentage of the alluvial gold is, however, from the small areas or patches of auriferous quartz eroded from the moutonnéd ridges, also a small percentage of gold has been deposited from passing alkaline waters that contain gold in solution.[5, 6]

The patches of auriferous quartz found generally at the base of the moutonnéd ridges as if eroded from them appear to have been transported (with the other materials composing the moutonnéd ridges) from auriferous reefs in the ridges forming the southeastern part of the Matagalpa system of mountains.

The boulders of bluish-colored rocks, auriferous and containing a large percentage of pyrites, found quite frequently in that region, are usually some variety of the soda-bearing hornblede rocks like glaucophanyte, although bluish trachytes, also bluish hypersthene boulders, some of them auriferous (probably all of them) were discovered. Some of the very interesting observations noted were: (*a*) The altitude above the Caribbean Sea (aneroid readings) of several of the hills and ridges in the region herein described is from 1,000 to 3,600 feet, consequently the flow of water to the Caribbean Sea, only 90 or 100 miles distant, is very rapid, there being no swamps, only those of brackish water in the delta of the rivers; this rapid descent of water from the mountains over numerous rapids, cascades and falls in the creeks and rivers offers many places where great water power or pressure could be had to move machinery for sawing logs, defibrenating plants, mining, etc.; (*b*) That region, excepting the clay-surfaced moutonnéd ridges, is covered, from two to twelve or more feet deep, with a very fertile soil composed in large percentage of partly decomposed vegetable matter (nitrogenous) and potash and other alkalies and alkaline earths, from the alkali-containing rocks, granite, feldspar, etc. Consequently there are excellent agricultural lands for corn, potatoes, coffee, tobacco, almonds, etc., on the sides of the hills and ridges, and suitable for sugar cane, plantains, bananas, cacao, India rubber trees, etc., in the valleys. Some of the mountain lands are admirable for coffee, and in the upper valley lands, indigenous cacao trees (Theobroma) of good varieties are numerous; (*c*) The climate is warm, but not uncomfortable, no lagoons nor swamps in the hilly region; (*d*) On the mountain ridges grow forests of large trees, among which mahogany, cedar, rosewood, sapote (Ulva sylvestra), iron wood, guanacaste and nispero appear to be the most numerous.

The tunoo trees[7] are also numerous and of large size, and, young vigorous-growing India rubber trees (Syphonia elasticos) are very abandant, while in shaded moist places, the surfaces of disintegrating rocks are frequently covered with the beautiful velvet vine of Nicaragua (first discovered about 1856 in Nicaragua), having

[5]Gold being invariably found in the granitic series of rocks, especially those of Palæozoic and Mesozoic eras and early Tertiary period, should, I am inclined to believe, influence us to recognize the gold as a constituent and not merely an accessory mineral in the rock.

[6]The fact of the existence of gold in rocks of the granite series appears to give support to the theory of the successional deposition of the elements in the earth, those of greatest sp. gravity being nearest to the earth's centre. Platinum, gold and iron appear to have been brought to the crust of the earth in every upheaval of granitic masma.

[7]The tunoo exudes freely, when scarified, a milky juice appearing like the milk or sap that flows from lacerations in an India rubber tree, but concretes into a gum like gutta percha. The fibrous inner bark is a texture of strong interwoven fibres and can be removed from the tree in pieces as wide as the circumference of the tree (from three to six or six and a half feet wide) and twenty to forty feet long. The Soomoos and Sambos use this bark as bed-clothing and as clothing for their bodies; they prepare the bark for these purposes after removing it from the tree by wetting in water and softening by beating it with sticks, when it becomes soft and remains very strong.

its exteriorly pure, white, trumpet-shaped, velvety flower tinted with various clear colors of purple, golden, pink, etc. Orchids in great variety are numerous, also ferns of all sizes, up to trees twenty feet high, are abundant.

This wilderness contains much undeveloped wealth in its export varieties of trees, medicinal and fibrous plants, and in its undeveloped minerals, metals, and very fertile agricultural lands, and has much to interest scientists, especially naturalists.

July 30.

A NEW REFLECTING AND DIRECT ACTING POLARISCOPE FOR THE ARC LIGHT PROJECTOR.

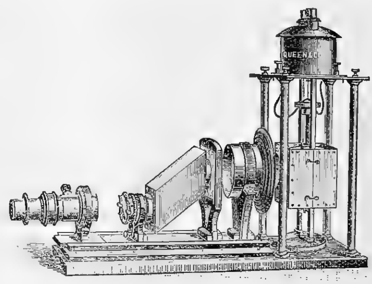
BY OSCAR KNIPE, PHILADELPHIA.

Referring to a paper on the subject of Projection, published lately in *Engineering* and several other periodicals, it was then indicated that most of the accessory instruments for Projection, among them the polariscope, would become more popular and find increased employment in the various courses of instruction. The arc light being so convenient, prompt in application and so perfectly satisfactory, suggests, of course, an extended application, and in consequence the expert will frequently find chances for improvement.

The favorite construction of the polariscope has been with Nichol's Prisms, two of these being employed, one for the polarizer and the other for the analyzer. To obtain brilliant effects it is necessary that the former should be at least two inches across the face; unfortunately it is now impossible to obtain such large crystals of spar, and as the demand for these instruments increases very much the reflecting polariscope again comes to the front; the old elbow arrangement furnished by some makers of instruments is a very clumsy attachment and inconvenient, as it requires the projector to be turned side-ways so that the light can reach the screen in front of the audience.

Various modifications have been proposed mainly by London makers and amateurs to obtain a direct acting reflecting polariscope by two opposite surfaces set in a box at the usual angle and deflecting the beam upward or downward, but the main objection, that of being inconvenient, still remained. The optical bench of the Paragon Projector offers, however, special advantages in that respect; the distance from the centre of the arc to the slide base being sufficient to allow a downward polarizer to be adopted, leaving abundant room for the object stage, objective and analyzing prism upon the bench. In practice this instrument is found to be simple in adjustment with the light, and the results obtained are surprising; the field projected is perfectly circular and even, alternating it light and completely dark by rotating the analyzer. The object stage here used is a novel devise; it consists of two uprights which open and close by a spring forming a clamp, a rotating ring with spring clips is secured to each clamp upright, so that three objects can be combined at one time, which is required for circular and eliptic polarization. The stage for exhibiting the phenomena of polarization in crystal, glass forms (verre trempe), and those produced by heating the object will be described at a future time.

The polariscope described above is specially adapted for plane and circular polarization of geometric and fancy designs of Selenite and Mica. The latter is easily obtainable and can be split into laminæ of various thicknesses, the thinnest that can be taken off in a square of about two inches is technically known as an eighth wave plate, the next thickness equal to two one-eighth films superposed is termed a quarter wave film and another equal to two one-quarter films superposed is the half wave film. The quarter and half wave films are the most useful in producing the most marvellous color combinations imaginable, not only in the gay primaries of the solar spectrum, but also in the more quiet grays and plain colors generally; taking a specimen composed of four or six strips of selenite about one-quarter of an inch wide by one and a quarter inches long, laid closely together, it will project its primary colors at once upon the dark field obtained by the position of the analyzer; the slightest turn to the right or to the left produces a change in the colors, but if we move the prism through one-quarter of a revolution the field is changed to a ground flooded with light and the colors have respectively changed to their complementary tint, the carmine has become a pale green, the lemon color an azure blue and so on; they are termed complementary because when superposed they produce white light. Allowing the specimen to remain, we take advantage of the rotary slip in front of our triple object stage and place there another specimen of selenite strips exactly like the first, but place it at right angles or diagonally and we now will have an illustration of the fact alluded to that complementary colors produce white light. The reason that only here and there a square or diagonal of real black or white is produced is found in the difficulty in matching exactly the films. After passing through the various changes, taking a note perhaps of the exact angle at which a certain color is produced so as to be able to repeat it afterward, we will remove the specimen from the front of the stage, and replace it by a quarter wave film; these have generally the axis marked on the edge by an arrow. We shall now obtain a decidedly different set of colors, which con be varied by rotating the analyzer; but notice now that instead of the two complementary colors we have a continual interchange of four or more colors, which can all be registered and repeated. When the quarter wave or half wave film is placed on the rotary clip at the back and rotated we obtain a different set of colors as well as



a colored background. A specimen representing three or four concentric circles, or a wheel divided into a number of sections joining at the centre or again a thin slab of selenite which is ground concave on its face, either of these will give the most beautiful and fascinating changes of color. As these various types of colors are absolute standards taken from the book of nature which can be exhibited precisely alike, it is obvious that we have here in this branch of polariscope study the most brilliant, complete and unchangeable system of color samples with their complementaries and color contrasts which far surpass any book of artificial colors. These when projected on the screen in a class become the objective point of every member, and can be pointed out, and commented upon by the instructor. As the geometric designs may be varied in composition, the mica films being very inexpensive, it requires merely a little patience and experience to produce an unlimited variety. The apparatus described in this article is made by Queen & Co. Incorporated of Philadelphia.

THE SENSE-ORGANS ON THE LEGS OF OUR WHITE ANTS, TERMES FLAVIPES, KOLL.

BY DR. ALFRED C. STOKES, TRENTON, N. J.

In an eyeless creature that habitually shuns some influence in the light, and lives in subterranean passages, or in tunnels or dark fissures within decaying wood, we should hope and rather expect, if we considered the matter solely from the human standpoint, to find either an extra number of sense-organs or a supply of an unusual variety, as a compensation for the absence of sight and for the limitations of a restricted environment. Such human expectations would be realized in the case of the white ants, *Termes flavipes*, so common within the rotting stumps and the fallen branches of our damp woods, for these Platyptera possess what may be considered to be an ample exchange for sight, for they have on all of the six legs a wonderful number and variety of sense-organs, which should certainly meet the needs of a peculiar life, as they doubtless do.

It is generally agreed among naturalists that certain insects, perhaps the greater number, possess some senses different from any owned by man and of which we therefore can have no idea. Sir John Lubbock says, "It is, I think, generally assumed, not only that the world really exists as we see it, but that it appears to other animals pretty much as it does to us. A little consideration, however, is sufficient to show that this is very far from being certain, or even probable."

On each of the legs of *Termes flavipes* there are seven organs which are plainly sense-organs, with three forms of appendages which may be sensory, but are probably ornamental only. The blind, subterranean *Termes*, then, with six legs and with seven sense-organs on each, is right well prepared for whatever may happen, even for the forceps of the predatory microscopist. The forceps conquers in the end, but the insects seem to feel its presence before it touches them, retreating and sometimes backing away from it as from some obnoxious object. Yet upon this apparent fact I should put no great reliance, as the observation was made with a single nest and late in the season, although the lateness of the season would probably have no effect, except to render impossible, as it did, a repetition of the experiment. It may, therefore, have been an event "viewed unequally."

The appendages referred to as being doubtfully sensory are mere elevations of the chitinous walls, ornamental in their arrangement, minute in size, and if possessing any special nervous connections, these have escaped my notice. The appendages, or ornaments, vary much in appearance on the coxa, the trochanter and the tarsus, the femoral and the tibial ones being similar to those on the coxa. On the latter the elevations are simply aculeate, the aculei being exceedingly minute; on the trochanter and on the femur they take the form of minute prickles, which, at first glance, appear to mark out the impressions of the chitinogenous cells, as in Fig. 1, from the femur; on the tibia the elevations become still more aculeate (Fig. 2); they are more widely separated, and the delicately elevated ridge which bears them gives the markings much the aspect of irregular, thick-edged scales, especially at the distal extremity, as in Fig. 3; on the tarsus the change from these clusters of aculei is abrupt, more or less semicircular scales, with thickened and elevated margins taking their place, as in Fig. 4, the edges of these being sometimes minutely denticulate. Viallanes, speaking of the situation of the sensory hairs of insects in reference to the chitinogenous cells, says that there are "two kinds of hairs, distinguished by their size and structure. The smaller spring from the boundary between contiguous polygonal areas, and have no sensory character. The larger ones occupy unusually large areas, surmount chitinogenous cells of corresponding size, and receive a special nervous supply." It is more than probable, therefore, that these minute appendages have in no place a significance different from that possessed by the minute elevations so common on the exo-skeleton of so many insects. But to notice the different form and arrangement on the different portions of the leg is at least interesting and suggestive.

The chitinous bristles, or "hairs" (Fig. 6), have here the usual form, and the structure described by Viallanes, being slightly constricted at base and inserted in a hemispherical depression as a socket-joint, and furnished with a nerve-fibre, of which Viallanes says: "The nerve expands at the base of the hair into a spindle-shaped, nucleated mass (bipolar ganglion-cell), from which issues a filament which traverses the axis of the hair, piercing the chitinogenous cell, whose protoplasm surrounds it with a sheath which is continued to the tip of the hair. Such sensory hairs are abundant in parts which are endowed with special sensibility."* On the legs of *Termes flavipes* these are, as elsewhere, sense-organs of great delicacy, with a sense of touch probably as sensitive as that of man himself.

In the same list with these sensory hairs may be mentioned organs of a similar character and of apparently great importance to the insect, which are found at the distal extremity of each tibia, each leg of the second and of the third pair bearing two, while those of the first pair have three. They are stout thorns, or spurs, projecting, in the first or anterior pair, two from the lower lateral margin of the tibia, with one from the upper lateral border, as shown in Fig. 9, where the other sensory hairs have been omitted.

They are conical organs, measuring about 1-450 inch in length, and are, during life, well supplied with nerve-substance. But that which gives them their unique character is the presence of a more or less circular aperture near the basal or tibial portion of the thick wall, as shown in Fig. 9, and more in detail by Fig. 15, each insect thus possessing no less than fourteen of these peculiar perforations. The circular aperture is externally surrounded by a thick-walled, elevated, marginal ring, and across it, apparently at the level of the general surface of the tibial wall, extends a delicate membrane, supplied with a rather conspicuous, centrally disposed nerve-fibre, as shown in Fig. 15, where a nerve is also delineated as passing from the tissues within the hollow of the spur to the mass of nerve-tissue which is here retracted from the walls, probably by the processes of preparation. Within the mass thus withdrawn ganglion-cells are plainly visible.

What may be the function of these fourteen organs, which are doubtless sense-organs of importance, must be left to the reader to explain. I do not know that they have been previously observed; yet it is more than possible that I may have overlooked some parts of the scattered literature of the general subject. If any plausible conjectures have been published in regard to the function of these or of similar organs, I should be pleased to know what they are, although all such statements must necessarily be conjectural. It is easy to state that certain depressions on the antenna of a bee are auditory or olfactory, but it is quite another matter to do more than to make the assertion. When it comes to the making of experiments to learn the actual function of these minute structures, the obstacles met with are practically insurmountable. But if these tibial spurs of the white ants, with their prominent basal apertures, have been previously studied, and if any probable guessing has been done as to

*Cf. "The Cockroach," by Miall and Denny, p. 30.

their character, I should like to know at what result the philosophical observers have arrived.

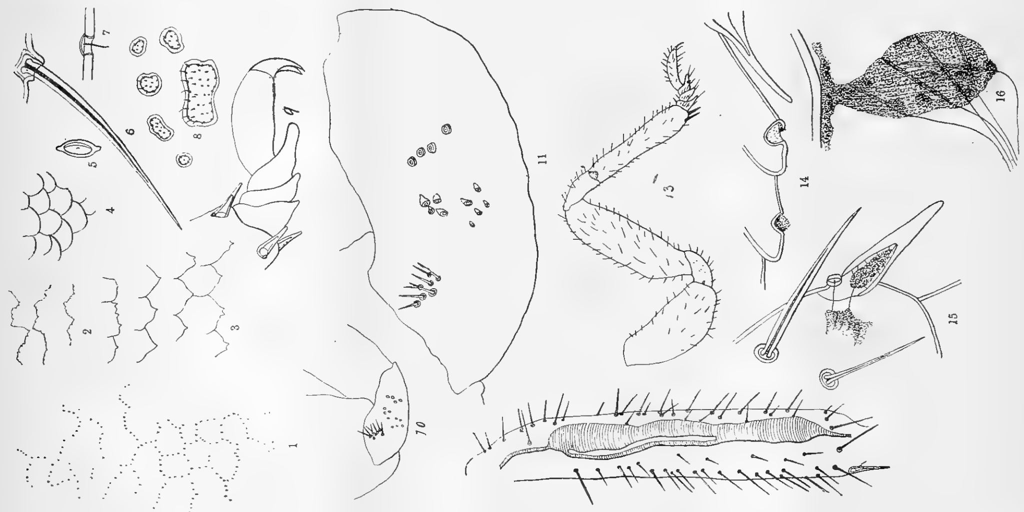
At first glance the organs might be supposed to be auditory, on account of the membrane, which closes them, and the only reason for rejecting such a supposition is that I have not seen any trace of the staff-like rods or the pyriform bodies which Graber found so well developed in what could not be imagined to be anything but organs of hearing in the tibia of the locust, *Locusta viridissima*, and of some other members of the same, or of an allied, order. The auditory organs of our white ants seem to be in an entirely different position and of an entirely different structure.

On the outer wall of the upper, or coxal, end of the trochanter is a group of just seven conical, setose and colorless hairs, surrounded by a circumvallate base, and on the upper outer wall of the coxa is another group of similar hairs, always ten in nnmber, and, presumably, having the same function. These groups are entirely absent from the inner walls. To show its locality, the cluster is exhibited on the trochanter by Fig. 10, and greatly enlarged in Fig. 11.

sides, and are sparingly scattered over the surface of the tibiæ. In Figs. 10 and 11 their general form and usual position and arrangement are shown, although in these particulars they are not constant. The number is also uncertain within known limits, varying on the outer side of each trochanter from thirteen to fifteen, thirteen being the common number; on the femur two and on the upper lateral wall of the tibia, from two to five, with sometimes an unusually large subcentral one, similar to a large one on the inner wall of each tibia; the inner walls of each trochanter also bear from four to five; on the upper part of the femur are from three to four; the central tibial surface has one, and one is near the lateral border of the distal extremity of the tibia.

In structure they closely resemble the circular apertures at the bases of the tibial spurs, each consisting of an elevated ring, having, at the level of the general surface, a delicate membrane furnished with a nerve-fibre, which elevates the centre into a minute but conspicuous papilla. These points are shown in Figs. 5 and 7, the latter being an optical section of a pit.

On the trochanters these organs are arranged somewhat



EXPLANATION OF THE FIGURES.

Fig. 1, surface markings from the femur; Figs. 2 and 3, from the tibia; Fig. 4, from the tarsus; Fig. 5, sensory pit from the tibia; Fig. 6, sensory hair from the general leg-surface; Fig. 7, optical section of a sensory pit; Fig. 8, pilose depressions on the lower end of the tibiæ; Figs. 10 and 11, sensory hairs, pits and hooded pits on the trochanters; Fig. 12, tibial trachea, with recurrent branch; Fig. 13, position of supposed tibial auditory organ; Fig. 14, pits on the lower surface of the first and second segments of the tarsus, one filled with crystalline excretion; Fig. 15, sensory pit at the base of a tibial spur; Fig. 16, tibial auditory organ, partly diagrammatic. All the figures are much enlarged.

These hairs differ widely in size, form, and general aspect from the sensory bristles of the general leg-surface. Underlying them is a specialized group of nerve-cells, which supplies each with a fine nerve-filament.

It is a fact worthy of note that these and other sense-organs are on the outer wall of the various parts of the legs which bear them, and that they either have no representatives on the surface toward the insect's body, or are there smaller and in much less abundance. Even the large sensory hairs of the general leg-surface are much fewer on the inner aspect of the legs.

In addition to these setose appendages, each trochanter bears other sensory organs, which take the form of elevated, circular, or oval rings, surrounding apertures of the same form in the thickness of the walls, some being capped by a conical, often oblique, hood-like membrane. They, as usual, are found chiefly on the external walls of the trochanters, but exist in fewer numbers on the inner

in three groups, according to size, and the three or four largest, resembling flat-topped papillæ pierced with a central depression above the membrane, frequently become confluent, those of the other two groups being capped by a conical, often oblique, hood-like membrane, as shown in Fig. 11. These hooded apertures bear some resemblance to the "canoe-cells" of certain authors, and which are said by Huxley to be only ordinary pits over-arched by a fine hair. In the present case, however, there is no arching hair, but a distinct hood-like elevation, which is especially conspicuous on the trochanters of the soldier.

It is reasonable to suppose that the capped depressions have a function differing from that of the flat-topped papillæ on the same surface. Those without the hooded covering seem analogous to the sensory pits discovered on the antennæ of certain plant-lice by Dr. John B. Smith, of Rutger's College (*Science*, Jan. 20, 1893). A rather hasty examination of the antennæ of the white ants does not reveal pits of any kind on the surface, although I am not prepared to say that they are not there. Dr. Smith also found on the posterior tibiæ of the plant-lice a series of the pits, exactly similar in structure, he says, to those of the antennæ in the male. Their function in *Termes flavipes* is as problematical, as Dr. Smith remarks in reference to the sensory pits of the plant-lice. They are present in both the workers and in the soldiers of the white ants, varying in the latter as they vary in the workers.

Perhaps the most interesting of these sense-organs, by reason of their position and of their probable character, are certain depressed spaces, several of which are on the tibiæ, and one on each of the first two segments of the tarsus, where the parts come in contact with the surface over which the insect may walk. With every step taken, these sense-organs perform their work, and probably leave on the surface walked over traces of the presence of their owners, as may readily be imagined, to impress the senses of those that follow. In all this remarkable collection of sense-organs there is none that seems to explain so clearly its reason for being as do these. Yet my supposition that they leave some special evidence of their owners' former presence which shall be manifest to the other members of the insect community, is based upon the observation of appearances in the tarsal organs of some individual *Termes* which are not apparent in those of others. This is that the deep depressions always present on the first and second segments of the tarsus are sometimes filled with a crystalline mass, which projects beyond the general surface as a hemispherical protuberance, especially, as it now seems, late in the season, and with presumably old subjects, thus suggesting the idea that the tarsal organs, at least, are glandular in function, and that the crystalline substance is the hardened secretion collected through abnormal, or sluggish, action of the parts.

On the tibiæ the organs referred to are shallow depressions in the wall, bordered by thickened margins, and with the plane surface of the shallow studded with delicate, exceedingly minute hairs, whose tips project slightly beyond the general level, and necessarily come in contact with any surface over which the insect may walk. The tibial depressions, while they are always present, are not always of the same outlines or of the same number. In some instances there may be one large depression with several small ones scattered about, as in Fig. 8, or the single large depression may be divided into several smaller portions, which shall be scattered over the region without any regularity of arrangement.

On the first and second segments of the tarsus the organs are always present, and always in the same position on the surface which must come in contact with the ground. Each of the two segments bears one in the form of a thick-walled, deep, hemispherical pit, the smooth inner surfaces of which are also studded with fine hairs similar in appearance to those of the tibial depressions, and with presumably the same functions. It is these hollows that are in many specimens choked with the crystalline excretion already referred to, and shown in Fig. 14, where one pit is filled and the other apparently in its normal condition. Each is plentifully supplied with fine nerve-fibres. Not rarely there are two pits, instead of one, on one or the other of the two segments; in a single instance, I have seen three on the second joint. But these hairy hollows deserve more extended investigation by some microscopist that may be more conveniently situated for that work than I am, and that may have the resources of a laboratory at his disposal.

To such an investigator, thus fortunately situated, the internal structure of these remarkable legs will also offer important subjects for examination. This is especially true of what I suppose, for reasons to be mentioned hereafter, to be the insects' auditory organs, one being present in each tibia, a supply of internal ears that would seem to be more burdensome than necessary or agreeable. (Fig. 13.)

It is possible that these organs may have some connection with the tracheæ, although that connection cannot be close; yet here, as in some other insects, the tibial tracheæ are specially notable on account of the sac-like enlargement of the upper and of the lower ends of the main tube, and of the presence of a smaller, recurrent branch, which leaves the upper inflated portion to enter near the lower at a varying distance from the extremity. This structure has been observed in the locust (*Locusta viridissima*), the cricket (*Gryllus campestris*), and in various Orthoptera by Graber; while Sir John Lubbock describes a similar arrangement in the tibiæ of the ants, especially in *Lasius flavus*. This tracheal structure is well developed in all the tibiæ of *Termes flavipes*, varying in the length of the recurrent branch and in the more direct or more undulating course of the main trunk of the trachea. In Fig. 12 is shown the appearance in one of the tibiæ of the white ants.

In the locust (*Ephippigera vitium* Serv.), according to Graber, and in certain other Orthoptera, the main tracheal trunk bears a collection of ganglion-cells and globules supposed to be auditory in function, at least in part, and which, if present in *Termes flavipes*, have escaped my notice. Yet in each tibia of this insect, situated near the outer wall of each, between it, the nerve and the trachea, is the more or less ovate organ referred to, the structure of which bears considerable resemblance to that of what has been accepted as a tibial auditory organ in certain of the Orthoptera. Its position near the upper third of the tibia of *Termes flaviges* is shown in Fig. 13.

It is connected with the nerve, and is itself formed of a collection of ganglionic cells and globules, with plainly developed, staff-like bodies, the apical extremities of which are conical, and through the middle of their apparently hollow length passes what seems to be a fibre, presumably a nerve. The external extremity is continuous with a nerve-fibre, five of which, with as many elongated, staff-like bodies, being easily made out, the nerves passing singly and separately up toward the femero-tibial joint, near which they are lost to view, especially after my imperfect methods of preparation.

Similar organs have been discovered by Graber in the tibiæ of the Locustidiæ, and by Lubbock in those of certain ants. In reference to the latter, Lubbock says: "At the place where the upper tracheal sac contracts there is, moreover, a conical striated organ, which is situated at the back of the leg, just at the apical end of the upper tracheal sac. The broad base lies against the external wall of the leg, and the fibres converge inwards. In some cases I thought I could perceive indications of bright rods, but I was never able to make them out very clearly. This also reminds us of a curious structure which is in the tibiæ of the Locustidiæ, between the trachea, the nerve, and the outer wall. * * * On the whole, then, I am disposed to think that ants perceive sounds which we cannot hear."

In *Termes flavipes* its position is somewhat different, although its situation and its structure are essentially similar to those referred to by Lubbock and by Graber. It is an organ of fibres, of ganglionic cells and globules, the latter being large and nucleated, and of the long, staff-like bodies already referred to. A partly diagrammatic sketch of the organ is shown in Fig. 16, its outer, narrow extremity being attached to the wide nerve just within the external wall of the tibia and the broad base directed toward the external wall of the trachea.

The rod-like bodies bear a rather remote resemblance to some observed by Graber, in what he considers to be the auditory organ of the locust, although in the *Locusta viridissima* there are also others broadly clavate and surrounded by a plainly delimited, granular substance.

In *Termes flavipes* there are no external appendages to suggest an auditory function, as there are in the locust and in some other insects, there being here only a slight concavity of the wall over the internal organ, and two or three of the sensory pits scattered about the surface. If the similar organs among members of the Orthoptera have such a function, it seems not unreasonable to suppose that such may be the use of these appendages within the tibiæ of our common white ants.

But, however this may be, the legs of these insects merit careful investigation by some competent observer, so situated that he may have access to all the luxuries of modern microscopical research, most of which are at present beyond my reach, my paper being, therefore, necessarily superficial and imperfect.

LETTERS TO THE EDITOR.

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

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

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

The Osage River and the Ozark Uplift.

Mr. Arthur Winslow's account of the Osage river and its meanders in *Science* for July 21, 1893, commenting on my previous suggestion concerning the development of that river in *Science* for April 28 of this year, has only lately come to my attention in looking over papers accumulated at home during vacation absence. It raises several questions on which discussion may prove of interest.

In explaining the existing meanders of the Osage and other deep-valleyed rivers of Missouri and Arkansas, Mr. Winslow maintains that the rivers had originally curved courses consequent on the form of the land on which they were initially formed; that these irregularities of flow are still perceptible, although they have been increased during the down cutting of the valleys; and that the down-cutting of the valleys and the general sculpturing of the region now going on is in consequence of an uplift that was essentially completed in Paleozoic time. I am not sure as to my correct understanding of the third point, although such appears to be Mr. Winslow's meaning.

The explanation that was suggested in my article included a long lost beginning of river development in Missouri; the attainment of an oldish topographic condition in the cycle of denudation preceding the present cycle; and an inheritance by the rivers of a meandering course, normally characteristic of the wide-open valleys of the preceding cycle, in the deep-sunk valleys of the present cycle.

Mr. Winslow's first point—that the existing meanders are simply exaggerations of initial consequent river courses—seems to me inadmissable for several reasons. In the first place, this involves the persistence through all of Mesozoic and Tertiary time of relatively trivial peculiarities of river courses, begun on the surface of the carboniferous strata about the close of Paleozoic time. It is certainly true that rivers are long lived, but it is very unlikely that the land history of Missouri has been so simple as to allow so extraordinary a perpetuation of relatively small river features. My reason for this opinion is not simply an *a priori* objection to the opposite view; but a careful examination of the developmental changes of other rivers. In Pennsylvania, for example, the changes in the course of rivers during a period corresponding to that of the land history of Missouri has been so great that I cannot think that the rivers of Missouri still maintain any close trace of their ancient initial courses down to these modern days. It is true that there has been much greater opportunity for variation of river courses among the tilted rocks of Pennsylvania than upon the nearly horizontal strata of Missouri; but to conclude that even in the latter region there have been no essential changes of river courses since the end of Paleozoic time implies to my mind altogether too passive a conception of post-Paleozoic time. It is impossible to say exactly what has happened, for the records are rubbed out; but to conclude that practically nothing has happened in the way of oscillation and warping and river change seems to me the most unlikely of all plausible conclusions.

In the second place, the postulate that the present meanders are directly descended from originally irregular consequent courses does not well accord with the distribution of deep meandering valleys in other parts of the world. They are not found in regions of one cycle of development; that is, in regions that are now in process of degradation following their first uplift. They characterize regions which for other reasons—of which more below—must be interpreted as having a composite topography; that is, having topographic features produced in two or more cycles of degradation. Moreover, the fact that the radius of the valley meanders is greater where the rivers have great volume is not consistent with the origin of the meanders from a control so irrelevant to river volume as the constructional inequality of the original land surface must have been.

Mr. Winslow's second point—that the existing meanders are increased in sinuosity over some former condition of meanders—seems to be an important correction to my brief explanation. It is a point that I had not in mind at the former writing; but in now recalling the form of the meandering valley of the North Branch of the Susquehanna in northeastern Pennsylvania, I see that the correction applies there as well as in Missouri. One might at first suppose that if a meandering river were uplifted, it would tend to straighten out its course, on account of gaining a stronger current; but it also seems possible that an even uplift with no change of grade (except by the action of the river itself in cutting down its channel towards the new base level) may even provoke an increased meandering, instead of straightening out former meanders. Professor J. C. Branner has in a letter called my attention to essentially this interpretation of certain deep meandering valleys in northern Arkansas.

As to Mr. Winslow's third point—that the present valley-making Missouri is the incompleted work of the denudation begun at the end of Paleozoic time—I cannot agree to this at all. Indeed, such a conclusion appears to me so improbable, and so contrary to both local and general evidence, that I fear it is not a correct statement of Mr. Winslow's meaning. He says: "The sculpturing of the topography [of Missouri] must have been uninterruptedly in progress from the end of the Paleozoic to the present time." He implies that the present altitude of the Osarks above the margin of the Tertiary strata in southeastern Missouri is the same as the altitude that the Osarks had above the waters in which the Tertiary strata were deposited; thus excluding all chance of tilting and local warping since that time. Differential movements have been determined even as late as in Tertiary and post-Tertiary time in the west; and there is good evidence of similar late geological movements in the Appalachians along the Atlantic slope. It therefore seems entirely improbable that Missouri should have taken an attitude at the close of Paleozoic time from which it has not since significantly changed and entirely impossible, if it had done so, that so little advance in denudation of the uplifted mass should have as yet been accomplished. There is every indication that before the close of Paleozoic time, the region which we now call Missouri suffered many oscillatians of level, for its strata are varied in composition and are separated by slight unconformities. The unconformable superposition of the Cretaceous and Tertiary strata of the Mississippi embayment on the denuded surface of the deformed Paleozoic rocks indicates that changes of level and warpings occurred during and after Mesozoic time not far from the region under consideration. In the absence of direct evidence of actual stability, moderate oscillations of level through vertical distances of a few hundred feet, or perhaps as much as a thousand feet, with slight warpings involving slants of a degree or two, should, I think, be regarded as characterizing the post-Paleozoic history of Missouri, as well as its Paleozoic history.

Just when the post-Paleozoic oscillations occurred, and just what was their amount is not determinate; but the latest important oscillation of the series is the one to which I would refer the permission of the rivers to cut their present deep valleys. The various brief and subordinate oscillations associated with glacial invasions and deposits of loess are complicated beyond clear understanding at my distance from their local evidence.

But oscillations being neglected, if Missouri had had only one cycle of denudation since its uplift at the end of the Paleozoic, it could not still be a highland. If the present altitude of the Ozark uplift with respect to its surroundings had been taken at the end of Paleozoic time, as Mr. Winslow supposes, why is it not all consumed now? The sufficiency of subaerial erosion to reduce great uplifts to lowlands in less than the whole of post-Paleozoic time is, I believe, well demonstrated. I do not mean to say that this demonstration is generally accepted; for curiously enough, there is a prevailing hesitation of belief on this subject. Geologists have not as a rule given the matter much attention, but this does not weaken the validity of its demonstration. Those who have carefully looked into the matter, are, I think, convinced of its correctness. Others with whom I have talked on this question, having their own special studies in other directions, have expressed a general incredulity about it, doubting that Mesozoic time was long enough to wear down mountains to peneplains; but their doubts have not taken the form of effective argument. Such doubts might have more value if we had not in many well-known deposits of stratified rocks, the direct evidence of the sufficiency of erosive forces to accomplish great results within definitely limited divisions of the geological time scale; and if we had not sufficient studies of land forms to show that even a part of post-Paleozoic time is long enough to baselevel uplifted masses. Referring only to examples with which I am personally familiar, I may mention the following districts as instances of effective base-levelling within determinate geological periods:

The plains of the upper Missouri, about Fort Benton, Montana, consist of Cretaceous strata, having a broadly rolling surface of slight relief over large distances; but here and there, surmounted by lava-capped mesas, or by necks and thick dikes of lava, whose present position can only be explained by supposing that the strata of the surrounding plains once rose at least as high as, if not higher than, these eminences. Yet this greater mass is now reduced to a peneplain; and since its reduction to a peneplain, it has been uplifted by a considerable amount, and the present trench-like valleys of the Missouri and its branches have been cut down two or three hundred feet. All this has happened since the deposition of the Cretaceous strata, of which the plains are there built. It is true that the strata of the plains are not particularly resistant; but neither are those of the Missouri plateau.

The Triassic formation of Connecticut and New Jersey has been base-levelled since it was faulted and tilted from its original horizontal position. Since it was base-levelled the resultant peneplain has been again uplifted, and its sandstones have been reduced to a second base-level, while its very resistant trap rocks retain, more or less perfectly, in their crest lines an indication of the altitude to which the older peneplain was elevated. The first work of denudation, by which even the trap sheets and the adjacent crystalline rocks were effectively base-levelled, was a post-Triassic work; the second denudation, by which only the weaker sandstones were base-levelled, is roughly dated as post-Cretaceous. The base-levelled sandstones are now trenched, in consequence of a late, or post-Tertiary, uplift.

In Pennsylvania the mountain ridges that are generally described as the remnants of the Appalachian or post-Carboniferous folding and uplift, cannot be legitimately so considered in the light of existing evidence. Their extraordinarily even crest lines, entirely out of accord with their folded structure, but closely in accord with one another, can be interpreted only as surviving indications of the peneplain to which the whole mountain system was reduced while the region stood lower than it now does; and the wide open valley lowlands between the ridges are the product of denudation since the uplift of the peneplain. These valley lowlands are trenched by the streams, in consequence of a still later uplift. The dates of these features are apparently identical with their relatives across the Delaware in New Jersey.

The upland of the Appalachian plateau in western Pennsylvania is a surface of denudation, trenched by valleys. The upland is accordant in altitude with the even crest lines of the Appalachian ridges.

The Hudson River flows through its crystalline Highlands in a deep, steep-sided valley. Further up stream, above Newburgh, where the rocks are weaker, the valley is opened into a broad lowland. Both the gorge of the Highlands and the open valley lowland further up stream are the work of post-Cretaceous erosion, and probably of less than all of Tertiary time. The valley lowland is trenched, indicating a late Tertiary or a post-Tertiary uplift.

Examples of this kind might be increased in number from the western surveys, but I shall leave observers there to speak for themselves. They all teach one lesson, namely, that in rocks of moderate hardness Tertiary time was amply long enough to allow the formation of wide open valleys, even to produce peneplains of faint relief on such rocks as the Triassic sandstones of New Jersey, the Paleozoic shales and limestones of Pennsylvania, or of the middle Hudson valley. It was long enough to form narrow valleys in rocks of excessive resistance, like those of the Hudson Highlands.

Is not this conclusion applicable to Missouri? The rocks along the Osage are not of notable resistance. How, then, can its valley slopes be steep if they are so old as all of Mesozoic and Tertiary time! That measure of time has elsewhere easily sufficed to wear out highlands into lowlands, to uplift them again, and enter well upon their second effacement. How, then, can Missouri be still so little advanced in the sculpturing of its topography, except by reason of the relatively recent renewing of the task! It seems to me utterly impossible to explain the valleys of Missouri as a product of one geographical cycle; the product of sculpturing that has been "uninterruptedly in progress from the end of the Paleozoic to the present time."

Having thus far taken the negative side on some of Mr. Winslow's propositions, I will now turn to the positive side of the argument in support of my own views.

Enough has been said to show my reasons for thinking that the initial courses of the drainage on the Paleozoic strata at the time of their first emergence are long since lost. Let me now consider the evidence of composite topography in the Ozark plateau, and the evidence that indicates an uplift between the production of the more gentle forms of the upland and the steeper slopes of the Osage valley and its fellows.

The Missouri reports frequently make mention of the relatively even surface of the upland country, and its contrast with the steep sides of the ravines in which the streams now flow. The upland is not level by any means, but has gentle swells and broad slopes, distinctly unlike the sharper slopes of the ravines. The process by which the present ravines are forming is not a direct continuation of the process by which the gentler slopes of the upland were formed. The former are incised in the latter; the latter have suffered little change during the excavation of the former. What, then, is the origin of the upland? It is not a constructional form; that is, it does not retain the form of strata deposited under water and simply uplifted into a land surface. It has manifestly been eroded, and thereby changed from its original constructional form. Under what conditions can a gently rolling surface be formed by erosion? Only as the penultimate result of long erosion, whereby the initial valleys have been deepened close to base-level and widened so as almost to consume the intervening hills; that is, the rolling upland must have gained an oldish topographic stage, when the erosive forces were acting with respect to a base-level different from that which now controls them, and with respect to which they are trenching deep valleys in the upland. The region must have stood lower when the wide rolling uplands were fashioned than it does now, when the upland is incised by steep-sided valleys. The change of elevation, by which the older cycle was closed and the present cycle was opened, was only long enough ago to allow the excavation of narrow valleys in rocks of moderate hardness; and hence, according to the time scale above indicated, this uplift was not longer ago than somewhere about late Tertiary time. The uplift revived the oldish streams that then flowed gently in wide open valleys, and the streams at once began their new task of cutting down their basins towards the new base-level. They have not yet done much in this new task.

It is only as a part of this new task that the Osage has cut down its meandering valley. Making all allowance for increase of meanders during the deepening of the present valley, the river must have possessed significant meanders when the down-cutting was begun. Such a conclusion is quite consistent with the conclusion of the preceding paragraph; for a meandering course is generally characteristic of an oldish river, such as the Osage was when it was flowing across the formerly lowland surface of what is now the upland. I am therefore constrained to think that more than one cycle of development must be postulated in explaining the course of the Osage through the Missouri plateau.

Regarding the relations of the meanders of the upper branches of the Osage on their open flood plains and those of the lower course of the main stream in its deep valley, I am not confident that the suggestion of my former article is correct. Mr. C. F. Marbut, lately of the Missouri Geological Survey, now a student in our Geological Department, and of whose topographical work Mr. Winslow made mention, tells me that the wide valleys of the upper Osage are confined to the weaker strata of the Coal measures; and that the narrower valley of the lower stream occurs in the harder lower Carboniferous and older Paleozoic rocks. This introduces a complication in the problem that cannot be safely solved at this distance from the field; but a review of the topographical maps with this fact in mind gives no reason for withdrawing from the conclusion that the region has been pretty well base-levelled before the existing valleys were cut in it.

Several points that Mr. Winslow makes regarding the

Tertiary beds of the Mississippi embayment and the gravels within the Missouri valleys, I shall not attempt to consider, as they should be seen on the ground before being discussed. As far as presented, they do not overcome the various lines of evidence which point to changes in the level of Missouri since its Paleozoic emergence; the last of these changes being the one in consequence of which the present valleys were cut in the denuded surface of the region. W. M. DAVIS.

Harvard College, Oct. 31, 1893.

COON CATS.

SEEING Mr. J. N. Baskett's note on page 220 of the current volume of *Science*, concerning coon cats, I venture to inform you that I was struck with the extraordinary appearance of one of these cats owned by Mr. Will Carleton, who had it with him in the Catskill Mountains the present summer. I asked him about the cat and he told me the same fable which Mr. Baskett relates, but he went on to say that of course the story was incorrect and that in his opinion this peculiar race of cats from Maine is descended from some Perisian or Angora breed brought down to Maine by early French settlers from Canada. I believe that this was surmise on Mr. Carleton's part, but it seemed reasonable to me and if you receive no more satisfactory explanation in reply to Mr. Baskett's question, you are at liberty to use this.

L. O. HOWARD.

Washington, D. C., November 9.

PUMP WATER.

IN America we often observe that the farmer, in his efforts to economize the steps of the housewife, digs his domestic well in close vicinity of his drains and outbuildings, but I have yet to see at home so pronounced a case of unsanitary surroundings as I observed in Germany a short time ago.

The top of a tall wooden pump, which crowned the family well, just peeped out from a huge manure heap which completely surrounded it. So large was the heap that the pump handle had to be operated by a rope, and the water was carried beyond the heap by a small trough.

WM. P. MASON.

Rome, Italy, Nov. 2.

COON-CATS.

IN answer to Mr. J. N. Baskett's question regarding "Coon-Cats" in your issue of Oct. 20, 1893, I would say that this cross-breed of animals has been known for many years, more particularly in the State of Maine. The error attributing these mongrels to a cross between our domestic feline, and the raccoon, *Procyon lotor*, is as general as it is ridiculous; for it stands to reason that animals of different families could not interbreed. The notion is about as ridiculous as a prevalent story among the ignorant that (cat) owls bear their young alive.

The subject of "coon-cats," or sometimes called mule-cats, has been repeatedly discussed in many papers, and it is now generally conceded that this hybrid is the result of an alliance of our domestic tabby with some Oriental feline—probably the Angora. This cross would show the long, bushy tail of the Oriental species. But Mr. Baskett is in error in supposing these animals plantigrade, and if he secures a skull, which he can easily do, he will find that the dentition is pronouncedly feline.

These cats are quite common in parts of New England, and may be purchased at a very reasonable figure, and according to the demands and the supply in the cat market. Few persons are able to distinguish between genuine Angoras and these hybrids, and many are the unsuspecting buyers who have paid a high price for a common "coon-cat" worth not more than two dollars.

MORRIS GIBBS.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A very fine telescope, length extended, twenty-five inches, closed, seven inches. Power twenty-five times. Good as new. Cost $25.00. Will sell for the best cash offer. B. S. Bowdish, Box 165, Phelps, N. Y.

For Sale or Exchange for last editions of Standard Works on Vegetable Anatomy or Physiology: Practical Zoology, Marshall & Hurst; Elements of Embryology, Foster & Balfour; Zoology, Macalister; Guide to the Study of Insects, Packard; Geological Studies and Shall We Teach Geology, Winchell. Also have duplicates of Experiment Station publications which would like to exchange for any not in my file. L. R. Jones, Burlington, Vt.

For exchange.—Skins of Aegialites nivosa, Ereunetes occidentalis, Aunnodramus Arldingi. A. rostratus, Chamara tasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diego, California.

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

Wants.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

A GRADUATE in medicine, experienced, will prepare or revise scientific and medical manuscript for publication, read proof, compile bibliographies, &c. Will also consult New York libraries for persons out of town wishing references to rare works. Address M. D., 104 Cambridge Place, Brooklyn, N. Y.

SOME OF THE NEW BOOKS AT LOW PRICES.

Famous Voyagers and Explorers.—$1.50.

Mrs. Bolton has added to her *Famous* series of books another and an unusually interesting volume, "Famous Voyagers and Explorers." It is hardly comprehensive, as it gives the biographies of only a few typical explorers—Marco Polo, Columbus, Magellan, Raleigh, and the more prominent of our modern American explorers. Doubtless such names as the Cabots, Sir Humphrey Gilbert, De Soto, Cartier, Nansen and others are reserved for a second volume. Mrs. Bolton has a gift for this sort of writing, and she has here brought together a large amount of deeply interesting matter which otherwise could only be obtained by reading through a dozen or more separate volumes. The book is illustrated with several portraits.—*Boston Transcript.*

Our Great West.—$2.50.

The contents of the volume appeared serially in *Harper's Magazine* and *Harper's Weekly*, in which periodicals they attracted wide attention and favorable comment. Their importance fully justified their republication in a more permanent form. The book affords a more minute insight into the present condition of the West than can be found elsewhere. What it tells is the result of personal experience, fortified by information obtained from the best-informed and most reliable men in the localities under discussion, and set forth with admirable clearness and impartiality. It is a work to be read and pondered by those interested in the growth of the nation westward, and is of permanent standard value.—*Boston Gazette.*

Statesmen.—$2.00.

In the preparation of this work Noah Brooks has aimed to present a series of character sketches of the eminent persons selected for portraiture. The object is to place before the present generation of Americans salient points in the careers of public men whose attainments in statesmanship were the result of their own individual exertions and force of character rather than of fortunate circumstances. Therefore these brief studies are not biographies. Mr. Brooks had the good fortune of personal acquaintance with most of the statesmen of the latter part of the period illustrated by his pen, and he considers it an advantage to his readers that they may thus receive from him some of the impressions which these conspicuous personages made upon the mental vision of those who heard and saw them while they were living examples of nobility of aim and success of achievement in American statesmanship.

Men of Business.—$2.00.

W. O. Stoddard, who has just written a book published by the Scribners, on "Men of Business," tells how the late Senator Stanford chopped his way to the law. "He had grown tall and strong," says Mr. Stoddard, "and was a capital hand in a hay-field, behind a plough, or with an axe in the timber; but how could this help him into his chosen profession? Nevertheless, it was a feat of wood-chopping which raised him to the bar. When he was eighteen years of age his father purchased a tract of woodland; wished to clear it, but had not the means to do so. At the same time he was anxious to give his son a lift. He told Leland, therefore, that he could have all he could make from the timber, if he would leave the land clear of trees. Leland took the offer, for a new market had latterly been created for cord-wood. He had saved money enough to hire other choppers to help him, and he chopped for the law and his future career. Over 2,000 cords of wood were cut and sold to the Mohawk and Hudson River Railroad, and the net profit to the young contractor was $2,600. It had been earned by severe toil, in cold and heat, and it stood for something more than dollars.—*Brooklyn Times.*

Orthometry.—$2.00.

In "Orthometry" Mr. R. F. Brewer has attempted a fuller treatment of the art of versification than is to be found in the popular treatises on that subject. While the preface shows a tendency to encourage verse-making, as unnecessary as it is undesirable, the work may be regarded as useful in so far as it tends to cultivate an intelligent taste for good poetry. The rhyming dictionary at the end is a new feature, which will undoubtedly commend itself to those having a use for such aids. A specially interesting chapter is that on "Poetic Trifles," in which are included the various imitations of foreign verse in English. The discussion of the sonnet, too, though failing to bring out fully the spiritual nature of this difficult verse form, is more accurate than might be expected from the following sentence: "The form of the sonnet is of Italian origin, and came into use in the fifteenth [*sic*] century, towards the end of which its construction was perfected, and its utmost melodious sweetness attained in the verse of Petrarch and Dante." In the chapter on Alliteration there are several misleading statements, such as calling "Piers the Plowman" an "Old English" poem. In the bibliography one is surprised not to find Mr. F. B. Gummere's admirable "Handbook of Poetics," now in its third edition. In spite of these and other shortcomings, which can be readily corrected in a later issue, this work may be recommended as a satisfactory treatment of the mechanics of verse. A careful reading will improve the critical faculties.—*The Dial.*

Any of the above books will be sent prepaid on receipt of the publisher's price less ten per cent. The same discount will be allowed on any new book, not a text-book.

N. D. C. HODGES, 874 Broadway, New York.

SCIENCE

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QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, NOVEMBER 24, 1893.

CURRENT NOTES ON ANTHROPOLOGY.—NO. XXXV.

(*Edited by D. G. Brinton, M. D.. LL.D., D. Sc.*)

Census Bulletins Upon the Indian Tribes.

In these Notes, under date July 15, 1892, I called the attention of readers to the excellent work which was being done by the Eleventh Census in examining and reporting upon the present condition of the Indian tribes of the United States. The scope of the investigations was most properly extended beyond merely counting them, and embraced an inquiry into their modes of life, their physical condition, their progress in civilization and education, and generally into all those traits which make them a peculiar class in our nation, governed by separate laws, and treated by our government on principles adopted toward none other of the inhabitants of the land (Thank Heaven!).

This comprehensive investigation was placed under the charge of Expert Special Agent Thomas Donaldson, and ample evidence of the thorough and comprehensive manner in which he has completed his task is offered by two more Bulletins recently issued. One of these is on the "Eastern Band of Cherokees of North Carolina"; the other on the "Moqui Pueblo Indians of Arizona and the Pueblo Indians of New Mexico." They are both in large quarto, abundantly illustrated with photographs, maps, and drawings by excellent artists. The text contains a really surprising amount of newly-gleaned, accurate, uncolored information, covering the individual and ethnic life of these peoples, not too specialized, and yet not superficial. These Bulletins must always remain a first-hand authority for students of the aboriginal race of the United States.

Early Central-European Art.

In the year 1891 two interesting objects were found at remote points in central Europe, both of them dating from about the first century of the Christian era, and both illustrating in an attractive manner the art, and incidentally the life, of that little-known epoch.

One was a large vase of silver, dug up in a peat bog at Gundestrup, in Jutland, Denmark; the other, a bucket (situla), unearthed on the banks of the Danube, above Vienna, also of silver. The former has been made the subject of a handsome publication by the Royal Society of Northern Antiquaries, Copenhagen; and the other has been lately described in full by M. Salomon Reinach, in *L'Anthropologie.*

The Gundestrup vase is elaborately ornamented with numerous figures of gods and goddesses, men and women, horses, dogs and other animals, in répoussé, retouched on the outer surfaces. The eyes of some of the larger heads are of colored glass, fixed on pieces of metal. The scenes portrayed are of hunting, war and sacred rites. There is evidently a Gallic inspiration, as also one from classic art; but the archæologists of the Society reach the conclusion that this is a specimen of Danish skill in the first century.

The situla from the Danube is also adorned with figures in relief, representing a civic or sacred procession, combining a pugilistic exhibition, horse and chariot races, musicians, etc. It also presents certain traces of Gallic art, along with others which must be attributed to Etruscan influences, which we know at one time extended far north in Europe.

These two beautiful specimens have justly claimed the attention of the artists and archæologists of Europe.

The Nude in Science.

We have, from time to time, plenty of talk about the nude in art; its importance in science, anthropologic science, is just being discovered. For a recent and suggestive communication on this subject we have to thank M. Gabriel de Mortillet, the distinguished archæologist and ex-President of the Anthropological Society of Paris.

In a late communication to that Society he points out how many features are concealed by the clothing, and urges the value of photographs from the nude. He recommends that these should be taken in three positions—full face, in profile, and full back. It is essential that the same posture should always be maintained, and the best one is the subject standing erect, the legs together, the hands dropped by the side of the body. He also recommends that a man and a woman of the same family or locality be photographed standing side by side, so as to preserve and exhibit the distinctions of sex—though he does not overlook the difficulties in the way of accomplishing this, fortunately overcome, however, in a number of photogravures which accompany his report.

The physical anthropologist will at once see how much information can thus be added about a race or stock. We learn the hairiness of the body; the inclination of the shoulders; the relations of hip and chest dimensions in the two sexes; the development of the breasts in both sexes; the prominence of the chest; the projection of the gluteal region; the proportion of trunk to extremities, and a number of other physical peculiarities. It is to be hoped that this valuable suggestion can and will be carried out on a large scale.

The Criminal In Anthropology.

To the historian, to the philosophic student of man, morality and criminality become terms extremely relative—often convertible. What a people at one time regards as a revolting crime, the same people a little later, or another people at the same date, regards as innocent, or even praiseworthy. One has but to turn the leaves of such works as Dr. Post's "Grundriss der Ethnologischen Jurisprudenz," or Dr. Steinmetz's "Ethnologische Studien zur ersten Entwicklung der Strafe"—treatises combining solid erudition, sound judgment and enlightened views—to find examples by the hundred. Men and women with unusually high moral natures have generally been regarded as unusually depraved criminals by their contemporaries, and treated as such; for instance, Socrates, Jesus, Hypatia, Bruno, Joan of Arc—the last mentioned burned, not as a captive, but as a sorceress.

Hence Mr. Arthur MacDonald, Specialist of the Bureau of Education on the Relations of Education to Crime, in his useful handbook just published by the Bureau, entitled "Abnormal Man," correctly defines such a man as one whose "mental or moral characteristics are so divergent from those of the ordinary person as to produce a pronounced moral or intellectual deviation." Any such deviation disturbs the bourgeois, offends good society, and brings upon itself the condemnation of the ministers of the law and the popular religion of a well-ordered community. The "abnormal men" include enthusiasts, reformers, men of genius, idiots and professed criminals. Mr. MacDonald deals with all these misgrowths with impartial hands, and presents a great and valuable mass of material for study about them, drawn from many writers on sociology and anthropology. His book is, therefore, an extremely useful contribution to our knowledge of these curious beings.

Extension of the Dakota Stock.

An interesting proof of the great value of linguistics in the study of ethnography is offered by the investigations of various observers into the extension of the Dakota or Siouan linguistic stock.

It was long supposed to be confined to the northwest, with an extension to the south among the Osages. The Mandans of the Missouri River spoke one of its dialects, and George Catlin, the artist, more than fifty years ago, expressed the opinion that they had migrated westward from the upper Ohio valley or farther east. But it was not until Mr. Horatio Hale, by an examination of the language of the tribe of Tuteloes, on the Roanoke River, in Virginia, proved that they spoke a clear dialect of the stock, that proof was at hand to show that portions of them lived in historic time on the Atlantic seaboard, and were encountered there by the doughty explorer, Captain John Smith.

There is some reason to believe that the Catawbas of the Carolinas are another branch; and in his late address before the Section of Anthropology of the American Association, Mr. James O. Dorsey offered evidence which places beyond doubt the supposition that the Biloxis, on the Gulf shore of Louisiana, are a colony of the same stock. He further advances the opinion, drawn from the nature of the linguistic changes which have taken place, that about 1,500 years have elapsed since these and the main body of the Dakotas severed their relations.

BIRDS WHICH SING ON THE NEST.

BY MORRIS GIBBS, KALAMAZOO, MICH.

Among birds, the females do not sing, and although many species have musical call-notes and agreeable tones in conversation, which are shared in by both sexes, still the true song is only rendered by the male bird. I am sincere in saying that the lady bird talks more than her mate about the house, but I will admit that when away from home she is very discreet in this respect. In attending to her duties of incubation she is very quiet, and it is seldom that a note is heard from her while on the nest. It has even been said that all birds are silent when incubating, so as to avoid observation. However, although most species are quiet when setting, there are a few which chirp loudly when so engaged, and some even burst into exuberant song.

Few observers are aware how assiduous are the attentions of the two birds to one another during incubation, and the credit which is due to the father-bird in his devotion in covering the eggs in his mate's absence is not allowed him.

Of course, when a bird is heard singing on the nest we know that the notes come from the male; but many young observers are inclined to attribute the song to the female. Another source of error in failing to identify the sex occurs with those species in which the singing male assumes the plumage of the female until the second or third year.

The chipping sparrow sometimes sings his chattering refrain while upon the eggs. Yellow warblers are not rarely heard singing from the nest, but one has to wait patiently in a neighboring copse, at the proper season, in order to hear, see and be convinced.

I have once heard the Maryland yellow-throat's song from its concealed nest in the grass; in fact, I found the nest, from hearing the peculiar notes, almost at my feet. Several times the song of the house wren has reached me, coming from the cavity where the old bird was sitting solacing himself in his gloomy nesting spot.

Once, each, I have heard the notes of the black-billed cuckoo, scarlet tanager, orchard oriole, goldfinch and the hermit thrush, the latter the only thrush whose song has positively reached me from the nest. One would think that the brown thrush, cat-bird and robin, as great singers, would burst forth on the nest, but it must be borne in mind that these thrushes all prefer higher perches for singing, while the hermit is a ground nester and often sings on the ground.

But of all the species which are musical while setting, the warbling vireo heads the list, both for persistence and for beauty of song, according to my note-book. Anyone can listen to the song of the warbling vireo on the nest if the trouble to find a nest with eggs in May or June is taken. For when the mate takes his trick keeping the eggs warm, he cheers himself, and enlivens the surroundings by pouring forth his rippling, inspiring melodious warble. I have heard him sing from the nest in early morning; in the hottest part of the day, and in the early twilight, and I have heard him issue as many as twenty bursts of song during one spell on the nest, and have discovered the nest on more than one occasion by the sweetly modulated tell-tale song.

These ten species are all the birds which I have found to sing while on the nest.

—The sixth annual meeting of the Geological Society of America will be called to order at 10 o'clock A. M. Wednesday, Dec. 27, in the Hall of the Boston Society of Natural History, corner of Boylston and Berkeley streets. Prof. William H. Niles, the President of the Natural History Society, will welcome the Geological Society. It is proposed to hold the sessions of Thursday at Harvard University, in Cambridge. Titles and abstracts of papers should be sent to the Secretary immediately, as it is desired to issue the list of papers not later than Dec. 12. Matter for the programme distributed at the first session must be in the Secretary's hands by noon of Tuesday, Dec. 26. Until Dec. 22, the address of the Secretary will be Rochester, after that date at The Thorndike, on Boylston street, Boston. Excellent facilities will be given for use of lantern illustrations. In place of the formal lecture on Wednesday evening, it is proposed to hold a regular session for reading of papers. Following an early adjournment there will be an opportunity for social introductions. On Thursday evening the annual dinner of the Society will be held, probably at The Thorndike. No special railroad rates are obtainable. "Holiday rates" are given during the week on some lines.

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CURRENT NOTES ON CHEMISTRY.—IV.

(*Edited by Charles Platt, Ph.D., F. C. S.*)

ADVANCE IN THE ANALYTICAL CHEMISTRY OF RECENT YEARS.

PROF. ALBERT B. PRESCOTT has outlined some of the most distinctive advances of analytical chemistry in a paper read before the World's Congress of Chemists. First we have "the resolute attempt to find out the composition of matter, as a whole, in any and all of its mixtures of whatever source." Complete analysis, proximate and ultimate, of complex substances has been entered upon, and "undetermined residues" have been made the beginning instead of the end of chemical research. The courage of analytical effort in recent years has been seen especially in the elaboration of methods for the isolation of carbon compounds, both natural and artificial. Proximate organic analysis has been called for by many practical workers, and we are now enriched by the labors of thousands in this field, which was opened largely by Dragendorff and Hoppe-Seyler. We have an increased knowledge of the molecular structure of bodies produced by nature—mineral, vegetable, and animal, as well as those of artificial production. Important advance has also been made in the employment of physical methods of inspection whereby molecular change is avoided. We have but to mention in this connection the multiplication of optical methods, the polarimeter, the refractometer, the spectroscope, recent studies in molecular mass, the freezing and melting points, solutions, adhesion and capillarity.

An exhibition of advance made is furthermore found in the reciprocal benefits of scientific research and of technical skill as seen in the work of experts in biological and pathological analysis, sanitary and forensic analysis, in the industries, and in agriculture and metallurgy.

SODIUM PEROXIDE IN ANALYSIS.

Probably no other recent addition to the reagents of the laboratory has become of such importance as has the peroxide of sodium, Na_2O_2. Its superiority as an oxidizing agent is firmly established, both because of its purity and because of its rapidity of action; and while but a few years ago it was something of a curiosity, it is now an article of commerce used in industrial operations, as well as in the finer applications of the laboratory. So long ago as 1871 Dr. John Clark pointed out, through the *Chemical News*, the strong oxidizing power of a mixture of caustic soda and calcined magnesia, and, a little later, illustrated the value of this action in the analysis of sulphides. As Dr. Clark states in a recent paper in the *Journal of the Chemical Society* (London), the exact cause of the above action was not quite clear at the time, but has since been determined by him to be due to the formation of the peroxides of sodium and magnesium. Hempel shows the superiority of the peroxide for the detection of chromium and manganese, and for rendering titaniferous iron ore soluble, but considers that for the oxidation of sulphur compounds that the addition of sodium carbonate is necessary to reduce the violence of the action. Clark, however, in the article referred to, prefers to use the peroxide without admixture with carbonate, stating that when a sufficiently low temperature is employed there is less tendency to loss by spurting and the action is completed in less time. In the analysis of pyrites, the procedure is as follows: One part, by weight, of the pyrites is mixed with six parts, by weight, of sodium peroxide in a platinum or nickel crucible, placed about two inches above a very low Bunsen flame. Oxidation immediately sets in and the mixture becomes red-hot. A few minutes suffices for the action, and upon its completion the sulphur is easily soluble in water. The solution is acidified and the sulphur precipitated as barium sulphate. In the case of blende part of the zinc dissolves with the sulphur, so that when it is desired to determine the zinc also the mixture is acidified with hydrochloric acid and precipitated with sodium carbonate before filtration. Galena, after treatment with peroxide, yields part of its lead into solution, and it is therefore advisable to acidify slightly with nitric acid and to boil with excess of sodium carbonate, when all the lead will be rendered insoluble, and upon filtration the whole of the sulphur will be found in the filtrate. By fusion with peroxide, arsenic is converted into soluble arsenate, and may then be estimated by any of the ordinary methods.

Dr. Clark uses peroxide of sodium most advantageously in the estimation of chromium and in the analysis of chrome ore. The temperature should not be so high as to liquefy the mixture, but just enough to form a paste, under which condition the contents of the crucible shrink, leaving a space between the mixture and the walls of the crucible. The mass is extracted with water and the solution boiled to decompose any excess of peroxide if the chromium is to be titrated. The insoluble residue dissolves easily in hydrochloric acid, and should be tested for any traces of undecomposed ore. The beauty and ease of this process can only be fully realized by analysts who have had practical experience with refractory chromium compounds. The analysis of ferro-chromium is conducted in the same manner, the metal being first reduced to a fine powder and then mixed with six times its weight of peroxide. This reagent is also applicable with some modifications in procedure to the quantitative estimation of chromium in steel, and in the quantitative separation of manganese from zinc, nickel and cobalt, the solution in this latter case being made in cold water, to avoid decomposition, which gradually sets in. In the separation of zinc and manganese, the latter is thrown down perfectly free from the former by the addition of peroxide to the ammoniacal liquid, or, as is recommended in the separation of manganese and cobalt, that the cobalt should be in the highest state of oxidation, the sodium peroxide may be added to the cold acid solution before rendering it alkaline with ammonia. In the separation of manganese from nickel and cobalt it is advisable to redissolve and to repeat the operation. Another valuable application of sodium peroxide is in the breaking down of tungsten minerals for analysis.

In a paper read before the British Association, at the Nottingham meeting, Dr. S. Rideal and Mr. H. J. Bult propose the use of sodium peroxide as a substitute for alkaline permanganate in water analysis. It is hoped thereby to throw light upon the character of the organic nitrogen in the water by differentiation in comparison with the results obtained using potassium permanganate. With 1 gramme of the peroxide for 1-2 litre of water the total ammonia evolved equaled 0.027 parts per 100,000, while with the permanganate 0.050 parts per 100,000 were obtained. Repeating with the same water gave with the peroxide 0.026 parts, and with the permanganate 0.048 parts per 100,000.

The addition of a further quantity of sodium peroxide and further distillation failed to increase the amount of ammonia produced, hence it is evident that the peroxide does not break down certain of the nitrogenous contents, and it was found possible to obtain a fresh quantity of ammonia after the distillation with peroxide by adding the permanganate. Some of the results obtained were as follows:

Water.	Free NH_3	NH_3 by sodium peroxide.	NH_3 by potassium permanganate after the peroxide.
A,	0.01	trace	0.007
B,	0.001	0.004	0.011
C,	0.012	0.011	0.015
D,	0.021	0.024	0.057

Water.	Free NH_3	NH_3 by permanganate.
A,	0.01	0.008
B,	0.001	0.013
C,	0.012	0.027
D,	0.019	0.078

The sodium peroxide thus liberates a portion of the ammonia, and apparently this is included in that set free by potassium permanganate. There is evidently no ratio between the two, and hence we may have a means of differentiating. Wanklyn's method also indicates a differentiation of the nitrogen, but the problem is too complex to be of service. A water after being partially oxidized by the peroxide yields its nitrogen more quickly than water not so treated, and it is suggested that this is due to the partially oxidized nitrogenous substances being left in such a condition as to be readily broken up by the stronger reagent.

The Bacteriological Examination of Water.

According to C. E. Cassal, F. I. C., in a recent report abstracted in the *Chemical News*, the assertions that the bacteriological examination of water indicates its condition with relation to disease germs and that the analytical method gives the past history of a water rather than its present condition, are entirely devoid of foundation. "The so-called analytical method is the only one whereby a knowledge of the actual conditions of a water can at present be attained, whatever views may be held as to the degree of efficiency possessed by *any* method for arriving at an accurate knowledge of such condition." The bacteriological examination depends upon the successful cultivation of micro-organisms and their spores in a nutrient media, such as "nutrient gelatin" and meat broth, which may be carried out on a minute portion of a sample, and consequently can hardly be representative. The difficulties are in the method itself, in the small sample, in the particular treatment which is artificial and unlike the conditions of the body, and which, only if successful, gives some knowledge of the organisms present. Negative results are practically worthless. A further difficulty is the recognition of disease-producing germs as such when found.

Mr. Cassal is an extremist, but we have many such upon the opposite side, and undoubtedly we shall hear from them.

Nature of Red Phosphorus.

When exposed to the direct sunlight under water common phosphorus becomes covered with a red coating, and the same red modification is formed in abundance by heating in an atmosphere of CO_2, or other inert gas, to a temperature of between 235°–250°. The red variety is insoluble in carbon disulphid, undergoes no change in dry air, and may be heated to 250° without taking fire. The density is, furthermore, always superior to that of white phosphorus, though it is not constant, varying with the conditions of preparation. Commonly red phosphorous is spoken of as amorphous, and it was formerly so considered, but the error of this was shown by MM. Troost and Hautefeuille, who obtained a crystalline variety at 580° having a specific gravity of 2.34 (that obtained at 270° has a sp. gr. of 2.15). Mr. Hittorf had previously obtained a black crystalline variety by heating with lead to a red heat in a tube, without contact with air. After cooling, the lead is dissolved in dilute nitric acid and the crystallized phosphorus left as a residue. J. P. Cooke describes rhombohedral crystals of this substance.

The nature of red phosphorus has recently been under discussion in Germany. J. W. Retgers (*Zeitschrift fur anorganische chemie*) has made microscopic examinations in polarized light, and finds that the smallest and thinnest particles are distinctly transparent, though owing to their high index of refraction most of the light, with the exception of a central red glimmer, is internally reflected. When, however, the internal reflection is diminished by moistening with a highly refractive liquid, such as methylene iodide, the particles transmit a clear, ruby-colored light. In polarized light these show extinction in two mutually perpendicular planes, and they are consequently described by Retgers as crystalline, he considering the refractive power as too great to be accounted for by internal stress in an amorphous body. A few short prisms were observed, but the crystal system has not as yet been determined. Referring to the "metallic" phosphorus obtained by Hittorf, Retgers concludes that it is merely a better crystallized form of the red variety. The black color may be due to impurities, arsenic or lead. W. Muthmann criticises Retgers' article, and points out that red phosphorus is dimorphous, and that in the commercial product we have frequently a mixture of crystalline and amorphous forms. According to Muthmann, when phosphorus is heated in an atmosphere of CO_2 at 230° for 24 hours the product is principally amorphous, but is also crystalline in part. If the experiment is conducted in a glass tube the separation of the two is accomplished, as the amorphous variety sublimes and the crystalline does not. The sublimed portion has the optical properties of an amorphous substance. From the assumed greater purity of the sublimate it is argued that the presence of impurities, as for instance, arsenic, may favor the formation of crystals.

The Origin of Petroleum.

Among the papers presented in Chicago was one by Dr. C. Engler on the artificial production of petroleum, of both chemical and geological interest. Dr. Engler briefly reviews some of the better known of the various theories on this subject, as, for instance, that of Sokoloff, that petroleum was produced during the formation of our planet out of cosmical hydro-carbons, which, in the beginning, dissolved in the soft mass, separated from it later on. Mendeljeff assumes that water entering by fissures and chasms into the interior, comes into contact with melted carbide of iron, and produces by interchange oxide of iron and hydro-carbons of petroleum. The "distillation theory" is dismissed, for chemical and geological reasons—first, because it is difficult to conceive of the substance of plants being split up by distillation into petroleum without leaving a residue of charcoal or coke, while in nature, according to Dr. Engler, we have no connection between doposits of coal and the occurrence of petroleum. Another theory, defended by Whitney, Hunt, Höfer and others, ascribes the origin of petroleum to animal remains. To test this latter theory, Dr. Engler has conducted a series of experiments so successful as to demonstrate clearly its possibility, at least, if not its probability, from a chemical point of view. First, some thousands of salt-water fishes were distilled under strong pressure, with the production of a liquid containing nitrogenous bases such as pyridin, but having no similarity to petroleum. Recalling experiments of Wetherill and Gregory as to the nature of so-called "adipocere," the idea was conceived that possibly in nature the nitrogenated animal substances were destroyed and the fatty residue converted into petroleum. Animal fat (train oil) was submitted to distillation under a pressure of 25 atmospheres at a moderate heat of 300°–400°, and it was found that 70 per cent (or 90 per cent of the theoretical) of the train oil was transformed into petroleum. The same results were obtained from the other fats like butter, hog fat, artificial fats, the free, fatty acids, etc. Not only illuminating oils were obtained, but also the lighter hydro-carbons, gasoline, ligwin, benzine, etc., and in those parts of the crude oil which show a high boiling point were found and separated paraffin wax and lubricating oils. "As a matter of fact," says Dr. Engler, "I have found in the distillate obtained by decomposition of train oil nearly all of the constituents which have been separated from the natural crude petroleum, and even the gases, which, like natural gas, consist essentially of marsh gas." For the chemism of the formation of the hydro-carbons, Dr. Engler refers to a recent paper in the *Berichte der Deutschen Chemischer Gesellschaft*.

RETICULATION OF SPINDLE-CELLED SARCOMA.

BY A. COWLEY MALLY, MUNSLOW, ENGLAND.

No subject lends itself more freely to errors of interpretation than the description of the microscopical appearances presented by histological and pathological preparations.

Even the delineation, both manual and photographic, of the structure of the Diatomaceæ bear some semblance of uniformity in the descriptions of different observers. Still, to quote Dallinger, "In the present state of the theory and practice of microscopy, it would be extremely unwise to give absolute adhesion to what is now held, by some students of diatom structure of no mean repute and of unrivalled manipulative skill, to be the absolute structure of some of the larger forms."

The same observation applies with still more force to the former investigations, as it is impossible to compare and correllate either the methods of preparation, observation or interpretation of different observers. They all differ, as a rule, in some detail, and in addition there is not only a marked tendency on the part of histologists and pathologists to copy the methods, drawings and results of others, but also a great liability to subjective imitation through suggestion.

Before confining myself to the evidences of reticulation in sarcomal structures, I may mention that the appearance in Polymyxa, so interpreted, is perfectly evident in some individuals and absolutely imperceptible in others. When seen, it is extremely evanescent, and, therefore, can scarcely be looked upon as evidence of the existence of formed material, but rather as the effect of some temporary chemical or physical change in or upon the external surface of the protoplasmic mass. The same or very similar appearances may be observed in Volvox, which are equally erratic, but as they are unquestionably received as the evidence of formed material, the foregoing statement is put forward as only a conditional hypothesis.

The portion of the tumor from which the accompanying sketch is taken was placed in Muller's fluid twelve hours before the sections were cut. These sections were taken from the central portion, where the fluid had evidently no time to act, then slightly stained with carmine, mounted in balsam and in the usual way. On being examined the same evening with a one-sixteenth water immersion and No. 12 compensating eyepiece, it was found that the markings forming portions of the reticulations took a definite direction, that is, obliquely lateral to the long diameter of the cell. This lateral obliquity did not change on revolution of the stage, and therefore cannot be interpreted as the result of oblique illumination. In many of the cells a granular nebular nucleus was observed, connected by slender and almost phantom branches with the oblique lateral markings. At the junction of these branches with the nucleus their point of

insertion or outgrowth, as the case may be, seemed to be placed in the hyaline substance surrounding the granules, and unconnected with the granules themselves. This latter observation is not laid down as an established fact, but simply as something more than ordinary conjecture. At the points of junction with the lateral markings there seemed to be definite nodal enlargements increasing in frequency towards the edges of the cell, and the whole section had a peculiar watered-silk appearance, which it was found impossible to represent on paper.

On examination of teased preparations, it was evident that the sections were cut obliquely, as the cells appeared very much elongated; at the same time they showed no reticulation.

Sections from the same portion of the growth were treated with osmic acid and several aniline dyes without effect. I am, however, by no means skeptical as to the results which ought to be obtained in perfectly fresh specimens with chloride of gold. Its manipulation is difficult, owing to the nature of the tissue, changes in temperature, light and color definition, therefore annoyingly variable in its results.

I cannot endorse Chatin's statement, as quoted by Dr. Stokes on p. 374, No. 517 of this journal, that reticulated structure in amœboides and in the blood corpuscles of invertebrates is constantly and easily demonstrable. Chatin, in the previous paragraph, referred to osmic acid; it is natural to suppose that the organisms and globules were submitted to that treatment, a method which, at least in my hands, has proved extremely uncertain in its results.

In conclusion, allow me to request some of your very numerous correspondents to inform us if the spectroscope would give any material assistance in the solution of the true nature of these markings. (I, of course, mean the diffraction spectrum), my acquaintance with the instrument being limited to test fluids.

Since writing the above my colleague, W. F. Pentland, has persuaded me not to be too dogmatic with regard to the reticulation of the invertebrate corpuscles and individual (especially conjunctival) cells of invertebrates till after next spring, as in the meantime he intends working up the subject.

THE BACTERIOLOGICAL ANALYSIS OF WATER.

BY J. H. STOLLER, UNION COLLEGE, SCHENECTADY, N. Y.

WHEN, in 1881, Koch announced the gelatine culture method for bacteria devised by him, it was believed that one of its most important applications would be in the examination of waters with reference to their potable use. This method, as is now well known, renders possible an exact determination of the abundance of bacteria in water. But it was soon discovered that the mere demonstration of the presence of bacteria was of little value in estimating the qualities of waters, inasmuch as waters of unquestionable suitability for potable use often contained bacteria in considerable abundance. However, the general result was established that the numbers of bacteria are in relation to the amount of putrescible organic matter in the water.

The ideal value of the gelatine culture method not having been realized, it is probable that its true usefulness in water analysis has not been estimated as highly as it deserves. An experimenter who has familiarized himself with the distribution of bacterial life in waters will be able to form definite and reliable conclusions upon the basis of numbers of bacteria. This is especially true in the case of river water subject to polution by sewage from towns. Numerical determinations of abundance of bacteria having been made of samples taken at various points from the same river, a fair judgment may be formed of the amount of sewage polution at any required point. The first step requisite to be taken is to determine, for use as a standard, the numbers of bacteria in unpolluted water *in the stream under investigation.* Comparisons made with this standard give reliable quantitative indications of polution. Any access of sewage raises the number of bacteria above the normal for that stream and the excess is a definite indication of the extent to which the water has suffered polution. The standard is obtained by testing the water, both at such points and at such times as give the condition approaching nearest to purity for that stream. In general, samples taken from the head waters of the river, above the first town from which sewage polution is received, and at a time of continued fair weather when the water is free from rainwash, are best suited for the control tests. In regard to the effects of surface washings from the land by rains, as indicated by turbidity of the water, it is necessary to eliminate them from all tests by taking samples only when the water is clear. This rule being observed, comparisons of results give indications of the extent of contamination due to sewage.

It should be added that there are other conditions which enter in a minor degree as factors in the results of numerical determinations of bacteria. These are temperature of water, depth at which the sample is taken, point at which the sample is taken with reference to rifts and pools in the stream, free exposure to air and light (prevented in winter by ice), etc. Consideration should always be given to these conditions and as far as possible samples should be taken under similar conditions throughout in order to render the results comparable.

The writer, working in association with Prof. C. C. Brown, consulting engineer for the New York State Board of Health, in furtherance of his work in investigating rivers as sources of water supply, has made numerical determinations of bacteria for some six hundred samples of water from the Hudson and Mohawk rivers. A statement of the results of this work is given in the annual reports of the State Board of Health of New York for the years 1891 and 1892.

It naturally occured to us, early in the work here alluded to, that a method of differentiating sewage bacteria from ordinary water bacteria would be of great value as affording a more exact means of ascertaining the degree of sewage pollution than is possible by the method outlined above. Dr. Theobald Smith, of Washington, D. C., was then consulting bacteriologist for the New York State Board of Health and upon submitting the idea to him he informed us of a method of differentiating gas-producing bacteria from others which he had devised and published some time previously (*Centralblatt fur Bakteriologie*, Vol. VII., p. 302 and Vol. XII., p. 367) and which he believed was applicable to the end sought by us.

The method thus placed at our disposal consists in the use of a culture fluid of which sugar (glucose) is a component and which is placed for inoculation in tubes similar in principle to the ureometer employed by chemists. Bacteria capable of causing sugar-fermentation when introduced into such culture-tubes give rise to a gas the quantity and composition of which can be ascertained. In the application of this method to the bacteriological analysis of water its value rests upon the fact that the most common species of bacteria present in feces are gas generators. As is well known the most constantly occuring species of bacteria in feces is *Bacillus coli commune;* and for some time our experiments related to the determination of the abundance of this species in the waters under investigation by means of the characteristic quantity and composition of the gases which it generates in the fermentation-tubes. Later others of the more common fecal bacteria were isolated and studied with reference to their gas-generating character. In this way a method was elaborated by which, it is believed, there can be determined with approximate exactness the numbers of prevailing species of fecal bacteria in a unit quantity of water. This determination is taken as a definite indication of the amount of sewage pollution.

In the practical use of this method the procedure is as follows: The saccharine culture fluid contained in a set, say eight, of fermentation-tubes is inoculated with a measured quantity of water from the source of supply under investigation. The tubes are immediately placed in an incubator and kept at a temperature of thirty-eight degrees centigrade for forty-eight hours or somewhat longer. (This is favorable to the development of fecal bacteria and probable destruction of the greater number of ordinary water bacteria.) Those tubes in which gas has been developed are then examined withreference to the amount and composition of the gases present and note is taken of those which agree in these respects with the effects produced by known fecal bacteria. Finally upon these data the number of fecal bacteria per cubic centimetre in the water under examination is calculated.

A part of the results thus far obtained by the use of this method, together with a more detailed account of the method is published in the 1892 report of the State Board of Health of New York.

BRITISH STONE CIRCLES—V. OXFORDSHIRE, SHROPSHIRE, AND WELCH CIRCLES*.

BY A. L. LEWIS, F. C. A., LONDON, ENGLAND.

THERE is a well-known circle called the Roll-Rich, better known locally, however, as the "King-stones," four miles from Chipping Norton, Oxfordshire (Great Western Railway). It is 100 feet in diameter, and consists of fifty-four stones and fragments, varying from one to seven and a half feet in height, one to five and a half in width, and one to two in thickness. Many of these stand close together, giving the idea that the circle when complete may have been a continuous wall of enclosure; but this is a point on which the visitor can form his own opinion. Two hundred and fifty feet from the circle, in a direction 55° north of east, is a stone called the "Kingstone," 9½ feet high and from 1½ to 5 feet broad and thick; it is on the other side of the road which divides Oxfordshire from Warwickshire, and is therefore in the latter county. Though very similar in position to the "Friar's Heel" at Stonehenge, it would appear to be too far north to mark the point of sunrise; but it may have marked the point of the first appearance of light on the longest day. About 300 yards from this circle, in a direction 10° south of east, stand five stones called the "Five Knights," which are from eight to eleven feet in height and one to four in breadth and thickness. As they now stand they enclose a small square space, three of them standing in a contiguous line facing S. S. E., one standing four feet behind them, and the fifth forming the northeast side of the enclosure, but it is possible that the latter was originally a capstone on the top of the others, and has fallen into the position which it now occupies. The ground enclosed by these stones is two feet higher than that outside them; they may have been designed in connection with the circle, or they may not; this is a point for the consideration of the visitor. There is a monument very like the "Five Knights," some four miles south from Chipping Norton, at a place called Enstone. These stones are called the "Hoarstone," and are four miles from Charlbury Station (G. W. R.).

On a hill above Penmænmawr, on the north Welsh coast, there is a circle called "Y Meinen Hirion" (the long stones), eighty feet in diameter; seven stones from three to five and a half feet high remain upright, and one, eight feet long, lies prostrate; there are also sundry fragments and stumps. This monument, described in Gough's "Camden's Britannia" as one of the most remarkable in North Wales, is not unlike the Roll-Rich in character, but is smaller, and, as regards the circle itself, even insignificant. The ground toward the northeast falls rapidly away into a deep hollow, on the other side of which are lofty hills; but about 500 feet to the northeast, down in the valley, is a stone, now prostrate, nine feet long, five feet wide and two feet thick, and in the same direction, but about 400 further, is another prostrate stone of the same length and width, but twice as thick. These stones, placed like the "Friar's Heel" at Stonehenge and the "Kingstone" at the Roll-Rich, being down in a valley, do not themselves show up on the horizon against the rising sun, but they lead the eye directly to a hill on the other side of the valley, over the top of which the sun would probably rise on the longest day, as it is between 45 and 50 degrees east of north, and not very much higher than the circle. This hill, one on the north side of it, and the Great Orme, form a group of three, and we shall find that in the hilly districts of Great Britain triple summits or groups of three hills are often to be seen to the northeast of circles, from which it may be inferred that the circles were, for some reason or other, intentionally placed in such positions as to command views of triple summits in that direction.

There are two other circles which are only just over the border of Wales, in Shropshire, and are most conveniently reached from Minsterley, to which there is a railway from Shrewsbury. The farther and larger of the two is about seven miles from Minsterley, and is called Mitchellsfold; it seems to be slightly oval, the diameters being 86 and 92 feet; it consists of thirteen stones, varying from six to two feet in height, and one to three feet in thickness. There are also some fragments, but the original number of stones may have been from 27 to 30. Two hundred and fifty feet from the south side of the circle are two stones, fifty feet apart, the dimensions of which are from two to three feet each way; and half a mile due south was formerly a monument of some kind called the Whetstone, which may or may not have been planned in connection with the circle. The top of a high hill, called Stapeley Hill, is 50° east of north from the centre of Mitchellsfold (the same direction as the "Friar's Heel" at Stonehenge), and about three-quarters of a mile from it. Between the two is a single stone, now fallen, eight feet long. Still farther, in exactly the same line, on the other side of Stateley Hill, and at the same distance from its summit on the northeast as Mitchellsfold is on the southwest, is another circle, called the "Hoarstone," or Marshpool, circle; and beyond this, looking northeasterly, may be seen three low hills. The Hoarstone circle is about 74 feet in diameter, and consists of 33 stones and fragments, the general size of which is from two to three feet in height, width and thickness. The largest stone is in the middle of the circle, a little to the southwest of the centre, and is only three feet and a half high; but, as the ground is soft and swampy, the stones may be sunk to some depth in it, and their original height may have been greater, and, if so, the bottom of the central stone, which now leans to the southwest, may be nearly at the centre of the circle. Many of these stones have artificial holes in them; these are not ancient, but have been made by the miners, who fill them with powder and fire them when a wedding takes place in the neighborhood. Mitchellsfold, otherwise Madge's Pinfold or milking fold, is said to have received its name from a legend connecting it with a cow which gave milk enough for all honest people who wanted any, until some wicked person drew her milk into a sieve, from which time the cow disappeared. The fallen stone between the circle and Stapeley Hill is called the "Dun Cow," probably in connection with the same legend.

There is another circle on Penywern Hill, two miles south from Clun in Shropshire, but it is nearly destroyed; it appears to have been about thirty yards in diameter, and to have had an outlying stone ten feet high, 120 yards or so to the southeast†.

There is also a circle at Kerry Hill, in Montgomeryshire, eight or ten miles west of Clun, which, I am told, is about thirty feet in diameter, with a central block, like the Marshpool circle†.

*No. 1 Abury appeared in No. 529, March 24.
No. 2 Stonehenge appeared in No. 537, May 19.
No. 3 Derbyshire Circles appeared in No. 545, July 14.
No. 4 Somersetshire and Dorsetshire Circles appeared in No. 555, September 22.

†I have not seen either of these, and am indebted to Mr. Luff, a former resident of Clun, for the above information concerning them.

PELE'S FERNERY.

BY CHARLES FESSENDEN NICHOLS, M. D., BOSTON, MASS.

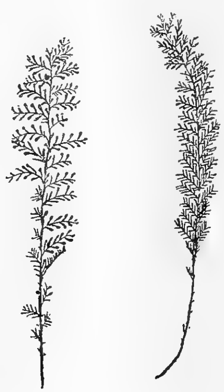
One Hawaiian morning, word was excitedly brought: "The cloud is off the pali and here are waiting Noo Loeloe (the Tired Lizard), Po Poki (Poor Pussy) and Wai Atlantika (the Atlantic Ocean), three merry natives all ready to climb the mountain, and why should not haoli (the outsider) join them? For it is but once in eleven years that Pele's cloud is off the pali.

Now who is Pele? And what is a pali? Any pali may become American soil and we ought to recognize it. The word simply means a high rock, or precipice, usually overhanging a mountain torrent; but Pele's pali, just here above the valley Waipio, enwrapped forever in the cloud which its great height attracts, is, with a considerable area of table-land, her own reserve. Superstition completely debars the natives from visiting this region; it is tabu ground,

"Death sure and swift awaits there,"

and nobody ever goes up to grope in the tangle of this beautiful cloud-garden of the very melodramatic goddess of Hawaii rei. To-day, however, so say these three natives, Pele withdraws her tabu. In compliment to the white haöli traveller, the secret-sacred, gray-fluffy cap, always hiding her white face* is, in part, removed.

Pele is the true ruler of Hawaii, not a queen or a princess to be bribed or pensioned dollarwise, goddess of infernal coquetry, of form so unstable that no idol has been fashioned for her worship, although she is held in such reverence as is given to no other, placable only when masquerading in some chaotic element, whose last footstep tossed molten lava, and who hides her rare garden where it finds its sunshine above the clouds.



Polypodium tameriscum, Hawaii.

Realizing then, O Lizard, Pussy and Wai Atlantika! that your tales are ever highly colored and that eleven days would, most likely, generously span the time wherein your mountain has lately remained under water (even a fish-story must come to the surface to breathe before its eleventh year), realizing all this, it is pleasant to know that the wind has changed, her trade-wind no doubt; such good fortune is not to be slighted, and so we will together ride to the pali.

On unshod horses, lassoed from a neighboring rice-patch, we ride, with slight ascent, through long weeds and grass. Looking backward, the curious illusion prevails, often observed on an island, that the water below appears to rise and confront us, as if we were lower than the sea whose lustrous furrows seem no deeper than warped surface of polished mahogany.

Birds are seldom seen on these islands, yet we can hear much twittering, as if made by little hidden birds. These birds are never captured "and if we were to see one," says Wai Atlantika, "we should be drowned." A few humming-birds are out to-day, and sand-mice, underground, make a noise between singing and chirping.

"Kauka" (Doctor), says Lizard, "it is time to be careful." Henceforth, at stated intervals, we dismount to place crisscross bunches (leis) of flowers and leaves, to propitiate the mountain deities (hoo-kupu).

Very safe it is to push aside the long weeds, seeking yams and ferns, for there are no snakes nor any other

Trichomenes pervulum, Hawaii.

venomous reptilian life on beautiful Hawaii; very safe, while listening to the monotonous chant of my companions "Aloha lio loa" (praise to the big horse), to scoop the fingers through a brook for small fish, then eat them alive. The natives do not even chew their squirming captives!

"Kahuna," says Lizard (he means native doctor, witch-doctor, sorcerer, and now addresses the outsider as such by reason of our increasing friendship), "my mother buried five of us alive." "Why?" I ask. "To stop the volanco," replies Lizard.†

There is no trail. We pass cacti, sprawling in families like turtles, oval, ragged and dusty, some rampant and pugnacious, others on their backs. The hau tree (Hibiscus tilaceus), the banana, the ti (dracœna terminalis), begonias and yellow blooms of the shrub ohenaupaka (scævola glabra) are seen in a maze of trailers, fungi and mosses.

Polypodium spectrum, above Waipio, Hawaii.

Fragrant wood-strawberries grow here and we may eat them with the slippery, sour guavas found on all sides. A valley to the right is completely overspread by nasturtiums of enormous leafage and the smallest possible blossom. Somewhat pathetic it is, this growth, so many years after its wrinkled seeds were planted by some New England missionary, not quite content with palmetto, *ohia*,‡

*Pele is represented fair and flaxen-haired. Tradition of northern voyagers visiting these islands deified them, taking note of their light complexion. Captain Cook and his sailors were worshipped, at first, as gods.

†Even at this time the burial of living children is not unknown on Hawaii. The writer remembers an old woman, seamstress in a mission family, who was supposed to have eaten several of her own children.

‡Ohia, the native apple (Metrosideros polymorpha).

orange and fern! And now, without frost to interrupt their progress, the nasturtiums have filled in, from edge to edge, this untrodden vale; the mass of vines is from twenty to fifty feet in depth and extends as far as vision reaches.

Tired Lizard proves to be chief chatterer; he is small, alert, shows white teeth, rides backward and stops at times to braid his horse's mane. My other companions, of the common stolid type, I remember now, only by their legs, so long that the two men seemed to stand over their small horses and could walk at option without dismounting.

Ferns abound here aud we may fancy their existence to be most joyous; knowing their right to the soil, sure that they are loved in all the land, for their beautiful life is not essential to the cruel worship of any evil god, they fill every nook or hang above us infested by big spiders. A loquacious Ophioglossum pendulum, embraced and festooned by a graceful piori (Smilax Sandwichiensis), attracts attention. But, without separate enumeration, we are aware of Blechnia Sadeleria cyatheoides, Davallia repens, with varieties of nephrodium, asplenium and pteris.

Gradually quitting firm land, our horses stumble at times, and sink to their chests in the mud; the weeds topple and flatten where a mountain stream gurgles; on one side lies a treacherous quicksand into which bullocks may sink and perish. Here we repeatedly dismount to cut the vines and roots which wind about the legs of the tired

Vittaria elongata, Hawaii.

horses. Ever pushing aside the thicket as we force our way, we are drenched by the water-laden branches of the tall shrubs; a dash, as if from a dipper, is thrown from tree or skirmishing cloudlet until our clothes drip as if we had waded through a river. 'Tis a sanatarium quite controlled by hydropathy. Warmth and reeking moisture are omnipresent; a height which in other lands would be the realm of snow attracts here only mists ever condensing into shower, and clarified by rainbow-sunshine. Under these conditions an enormous fernery is created where growths which could nowhere else mature revel undisturbed, unless the rarely veering wind stir for a moment the habitual quietude. Here the light clouds hesitate, touching the treetops, the soft wind bears no aroma but that of the mountain dews, earthy, evanescent, soothing. It is, indeed, the heart of the marvelously beautiful region to which we have aspired.

Ferns, where their life has full sway, inuade earth and air alike. Gleichenias travel, emulating the banyan and throwing out rootlets wherever their stalks touch the ground. Such as are parasites climb over one another, surmount the vast undergrowths, sway from tall trees and profit by their larger outlook—plagiarists and sycophants at very heart—to steal almost indiscriminately from the thousand forms outspread below. Again quitting their highest points of observation, charmed by the varied shapes which grow beneath, clinging and swinging downward, these marauders now steal the prettiest forms they spy. Polypodium spectrum outlines an oak leaf, Pteris decipiens miniatures the eaf of the rock maple, Polypodium tamariscum resembles the tamarind leaf, Vittaria elongata is indistinguishable from grass. Like the recognized imitation, or resemblance, on the part of certain birds, insects and many animals, of the leaves and trunks of the trees near which they dwell, these fern-counterfeiters often confuse the naturalist. The glass only detects fernship in many of the pretty parodists, revealing, on edge or surface of the leaves, their fine spores. Detection is often difficult (particularly in the case of Polypodium spectrum) except during the brief period of fruitage.

Tethering the horses, the natives now begin to place between thin pieces of wood the ferns we find. All will be fastened firmly together while the specimens are still fresh, before we go down the mountain. To collect ferns is to search, to shout, to be hungry, to wallow, to climb into far, wild places, until certain shy lives are, as it were, pressed into the service of science, receiving in captivity Latin names.

Polypodiums which, on the volcano, develop to fruitage in a few days, but are stunted, in the hot lava cracks, to a height of three or four inches, here exhibit long and graceful fronds. We find Polypodium pellucidum, P. pseudogrammaticus, and P. hymenophylloides, natives only at these islands. Pteris decora and Naratia Douglassi grow here only. The "Fanny fern" appears to be a hymenophyllum.* These, with many others, are found. An Asplenium enatum supports numerous young plants of its own variety which have enrooted themselves on the stems and leaves of the parent fern.

Wandering along the edge of the pali we see, on the low trees, charming pink shells. There are many varieties of these land-shells in the forests of the tropics, and a collection has been made and catalogued from Oahu, Maui and Hawaii.

The precipice drops, not very abruptly, about four hundred feet. Half way down, a great tree has fallen. Somewhat piteous and helpless the tree appears, devoured and ornamented by orchids, selaginellas, lycopodiums and pendant mosses, while every notch and gnarled limb supports parasitic ferns; among them are seen Trichomanes parvulum and the microscopically small Hymenophyllum lanceolatum, a pulpy mass with delicate projecting leaflets.

A giant pulu, the tree fern (Cibotium Chamissoi from which the natives gather the silky material with which they fill their beds),—this vigorous growth has forced upward an immense mass of earth upon which nestles the birdsnest fern (Asplenium nidus avis, throwing its vast leaves about as if to invite auks or phœnix to establish a nest here in Pele's service. It is now that Lizard wishes he could discover the secret cave of Umi, a great warrior said to be buried beneath this pali.

We look upward, seeking the little white rag which has been tied upon one of the horses for a beacon. A deluge of rain is pouring upon it from Pele's terrible forehead, signal for scramble, remounting and retreat.

Thus we saw her fair garden when the goddess was not at home; her soft cloud swept in and Pele's pali is but a memory, so intangible I could believe it a dream, were it not for my album.

*To Prof. Daniel C. Eaton, who kindly arranged my collections, I am indebted for the classification of these ferns.

MY NEW PRINCIPLES OF THE CLASSIFICATION OF THE HUMAN RACE.

BY G. SERGI, ROME, ITALY.

The chief principle consists in discovering many varieties in man, as in animal species. These varieties have internal and external characters: the former are persistent and fixed by heredity, and in man are durable for many centuries—according to my own observations, more than a thousand years. The external characters are liable to be changed by crossing the varieties. These characters, now, are very much mingled in various ways, so that it is not easy to distinguish one from another. These mingled characters are constant causes of mistakes in the classification of human beings.

The internal characters of the human varieties are in the bony frame, especially in the skull; the externals are the color of the skin and of the hair and eyes.

Until the human classification is made by external characters (Linneus, Cuvier, etc.), we cannot have one upon a natural basis. Very little experience of the various races of man, as now classified, shows that these are an intermixture of various ethnic elements, with the same or various colors of skin, hair and eyes. Elsewhere we find various colors of skin with the same internal characters of the skeleton.

The skull chiefly furnishes the characters of classification; it shows the external shape of the brain, the most important and the highest organ of man; the skull is the means of the classification of the brain.

Now, I have discovered in the human skulls various forms or types which are persistent by heredity; these forms, which we find in many individuals, are varieties of my primitive ideal form of skull in human beings. Again, I have discovered that the varieties comprehend sub-varieties by means of some new characters which modify the variety, or are superadded to the characters of the variety.

Therefore, I consider the shape of the skull as a natural basis of the classification of the varieties of man, because the varieties have a dependence upon a biological fact, viz., the natural formation by variations, as in animal species.

The various forms of the human skull have their origin from a series of anatomical facts: (1) From the various development of the bones of the human skull. (2) From the different curves of the bones, and from the different directions of these curves. (3) From the capacity of the skull.

It is true that anthropologists have often spoken of type of skull, but they have not defined this type; we can show it by the works of the German anthropologists, especially of Von Hölder, Ecker, Virchow, and others, of the French and Swiss anthropologists, as His and Rütimeyer, De Quatrefages and others. The Italian anthropologist, Mantegazza, has proposed a Linnean description of human skulls.

But all the anthropologists believe they can determine the form of the skulls by the measurements and the correlated indices.

This method of measurement, which Retzins introduced in anthropology, was suggested by himself and by subsequent scholars. Retzins classified the human races by means of the cephalic index, which is one character of the skull; he changed his classification four times in a few years, because his method was uncertain.

In my opinion, the method of measurements adopted for this classification is no method. The measures only discover some secondary characters of the skull; I have proved that, under the same cephalic index, we have many different forms of skulls, and under various cephalic indices we have the same shape of the skull. Besides, the skulls of all people of the world are dolicho, meoo, and brachycephalic.

I think that Blumenbach laid the true basis of anthropology in his little book, *De generis humani varietate nativa*, a century ago. He found that the human varieties are numberless, and investigated very accurately the causes of the variations in man, as in animals. But subsequent anthropologists have left off the Blumenbach principles, which should have been the basis of systematic anthropology and of classification.

Now, my object is to establish the basis of systematic anthropology on the shape of the skulls, without regard to measurements. For this purpose it is necessary to find a nomenclature of those forms which correspond to the varieties and sub-varieties, as we have done in zoölogy. The nomenclature is intended to distinguish one form from another, and to fix definitively the forms of the different varieties. Further, the nomenclature applies to the geographical distribution of the varieties and serves to analyze the various ethnic elements which compose the peoples of the world. Thus we can follow the course of human emigration and of mixture in various times.

I have attempted, in many sketches, to show practically the results of my principles and of my new method of classification of varieties. These sketches are the following:

African and Armenian skulls: General considerations on anthropology and craniology. (Archivio per l'Antropologio, 1891). The human varieties in Melanesia (Academia de Medicina de Parma, 1892). The human varieties in Sicily (Acad. dei Lincei, Roma, 1892). The human varieties in Sicily. (Acad dei Lindei, Roma, 1892). The human varieties in Lower Russia (Anali de Medicina 1892). The primitive inhabitants of the Mediterranean Sea (not yet published). The microcephalic varieties and pygmies of Europe (Acad. di Medicina di Roma, 1893). Catalogue of the varieties of man in Russia. Systematic classification of the primitive inhabitants of European Russia.

LETTERS TO THE EDITOR.

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

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

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

The Mechanics of Flight.

At the recent Aërial Navigation Congress in Chicago a paper was read on this subject which was published in *Engineering News* for Oct. 12. The paper has caused a great deal of discussion, which has appeared in the same journal for Oct. 26 and Nov. 16. I think it will be of interest to readers of *Science*, who may not have access to this paper, to give a few points in these novel views and to show how valueless they are in explaining the perplexing problem of the soaring bird.

The author has made a careful study of the flight of buzzards in tropical regions, and assumes, as a premise, that because he has not seen the bird move its wings, or any portion of them, therefore it must gain some assistance from air currents. It seems to me this is a violent assumption at the outset; surely our eyes at a distance cannot give us movements of wings which might be ample to keep the bird at a level, or it may be that the bird does not continue absolutely at the same level, though appearing to the eye to do so. At all events, this premise should not be granted, and should be proved by evidence far better than any thus far adduced.

The author thinks that the bird in flying with a current and down an inclined plain will gain energy from the current over and above that due to the descent, and this gain will enable the bird to turn and mount to a much higher plane than it formerly occupied. On the face of it I think this must strike every reader as extremely improbable and almost nonsensical. The opinion is strengthened as we continue on in the original discussion. Suppose a bird to be soaring at a speed of twenty miles per hour in a current which is itself moving at the same rate. It is very evident that this velocity must have been attained by the bird with almost no assistance from the air current, for the resistance of the air against the soaring bird it practically nothing. It is also evident that, if the bird continues soaring in this current, it must lose the velocity it had attained, and very quickly fall if not assisted in some way. If it descends in an inclined plane, its velocity, so far as the current of air goes, will not be changed in the least, for two reasons. First, it has the same velocity as the air current at starting on its downward path, and hence the air current could not accelerate it any more than if it had continued soaring in a horizontal plane. Second, as just suggested, the resistance of the air is practically nothing, so that the current will have no effect. The assumption that there is some occult assistance given to the bird, because it is going down an inclined plane instead of horizontally, will not be regarded as of any value by any one at all familiar with the simplest principles of mechanics.

But this is not all: an attempt is made to prove this occult assistance from a concrete example. The author takes a ship moving at twenty miles per hour and places upon it an inclined plane, whose vertical height is 13.38 feet, which is the distance through which an object must fall to attain a velocity of twenty miles per hour. Now, if a ball should be allowed to roll down this inclined plane, it would attain, so it is assumed, a velocity of forty miles per hour with respect to the water outside of the ship neglecting friction on the plane. This velocity of forty miles per hour is made up, as the author states, of the twenty miles per hour due to the motion of the ship or the initial velocity, and twenty miles per hour additional due to the acceleration from the fall of 13.38 feet in the descent of the ball on the inclined plane. It is perfectly plain that there is no occult effect coming in so far from the motion of the ship. The author shows that with a velocity of forty miles per hour, if the ball should roll upon an inclined plane fixed off the ship, it would rise to a point more than twenty-six feet higher than the starting point. This conclusion is quite startling, and shows a most serious fallacy in the reasoning. If the ball had rolled up an inclined plane fixed to the ship, it would have risen to exactly the same height as at starting, as was clearly shown by Prof. J. P. Church. That the ball would not rise to any such height will be clearly seen by considering what would happen if it rolled from its first position upon an inclined plane fixed upon the water. In this case it would rise exactly 13.38 feet, and its motion would cease altogether.

The vicious reasoning is brought out very clearly even in the original paper, for the author considers what would happen if the ball fell vertically instead of rolling down the inclined plane. In this case the twenty miles per hour initial velocity he considers as equivalent to a fall of 13.38 feet, and as the inclined plane is 13.38 feet high, the total fall would be equivalent to 26.76 feet, and he shows that with this fall the velocity attained would be 28.28 miles per hour. That is to say, a ball rolling down an inclined plane, where it must meet with a slight resistance, will attain an accelerated velocity of twenty miles per hour due to the fall of 13.38 feet; but, when the same ball falls vertically in free air, and where it meets with no resistance, its acceleration is only 8.28 miles per hour. I am sure nothing farther is needed to show the utter fallacy of all this reasoning. H. A. HAZEN.

Nov. 21.

PORTRAITS OF HELMHOLTZ.

I THINK it will be of interest to the many admirers of the distinguished physicist, Von Helmholtz, to know that on his recent visit to this country he was induced to sit for a photograph in the gallery of the well-known artist, Mr. Brady, of Washington.

Some most excellent pictures were obtained, copies of which may be obtained by addressing Mr. M. B. Brady, photographer, Washington, D. C.

The prices are: For the largest size, 9x14, $2.00; intermediate, 8x10, $1.00; cabinet, 25 cents.

The cabinet size and the others (*unmounted*) will be sent by mail. The larger sizes (mounted) must be sent by express, at the expense of the purchaser—usually 25 to 35 cents. T. C. MENDENHALL.

Washington, D. C., Nov. 7.

SONGS OF BIRDS.

HAD I not expected that we should have more satisfactory answers to the query as to whether the voices of birds expressed emotion or not, I should have ventured a word before now.

I think any student or observer of birds, who has carefully noted them with his heart in the study, will agree with me when I say that if there is such a thing as expression of emotion in voice, then bird voices most clearly express it. The mere fact that a bird soon forgot his loss and grief, and sang in the natural bouyancy of his spirits, or that another, lame and confined, was yet happy, and expressed his happiness in his song, certainly does not prove lack of emotional expression in the voices of birds.

The untrained ear may fail to detect the difference in the joyful and sorrowful notes of some birds, but surely the ear must be indifferent, indeed, that does not detect plain expression of sentiment or of joy in the happy song, or of sorrow in the disturbed wail of any of the common birds about our doors.

The gift of voice was unquestionably intended as a means of expression to all creatures thus endowed, and wherever our powers of comprehension enable us to hear and understand them aright, we cannot fail to detect expression in them.

This may seem a trivial matter to bring up at this time, but it seems hardly fair that we should pass over the matter without giving to birds and all other creatures their just dues. B. S. BOWDISH.

Phelps, N. Y., Nov. 1, 1893.

DICTIONARY OF SCIENTIFIC NAMES.

THROUGH your query column, permit me to ask if there has ever been published a pronouncing dictionary of scientific names in use in the study of natural science for the benefit of the young student who does not care to delve too deeply into the study of Latin, and if not, why would not such a publication be a welcome addition to our library? B. S. BOWDISH.

Phelps, N. Y., Nov. 9, 1893.

ORIGIN OF THE CARVINGS AND DESIGNS OF THE ALASKANS AND VANCOUVRE INDIANS.

A FEW years ago I crossed the ocean on a slow steamer in company with a returning missionary, who had spent fourteen years among the Vancouvre Indians. He had with him a large collection of carved implements and *fac simile* drawings of the quaint figures on their boats and other objects. His opinion was that they were Japanese in design; that at some time some people from that country had been blown across the Pacific, and left there traces of their arts, which were perpetuated. He thought there were some traditions among the Indians that pointed that way also.

In looking over the collections at the Exposition this summer it occurred to me to verify his conclusions.

In the Anthropological Building was a large collection of "totem poles," carved implements, and drawn figures from Alaska, also from California, Mexico, Central America, and Peru, as well as from other parts of the Americas. In many places Japan was largely represented.

There is a most striking difference between the arts of the western coast and the interior of America. They have something of the grotesqueness of Japan, but not much other likeness. They are akin to those of ancient Mexico, and would indicate that the arts and the people of the western coast were of like origin; that the "totems" and other figures of Alaska and Vancouvre are survivals of the arts of Central America and ancient Mexico.

P. J. FARNSWORTH.

Clinton, Iowa, Nov. 12, 1893.

On the Systematic Position of the Diptera.

As a student of diptera, I have been interested in the recent letters by Professors Packard, Smith and Riley in *Science*, on the systematic position of this order of insects, and wish to express my entire concurrence in the views presented by these gentlemen. That the diptera, or some of them, are the most specialized of insects—that they depart most from the primitive type of insects—seems to be almost without argument; but that they therefore hold the highest position among insects by no means follows. Even the advocates of the supreme rank of the order have never ventured to carry their conclusions to the logical ultimatum, and give to the sheep-tick, or, better yet, the wingless, eyeless bat-tick, the highest rank. That the bat-tick is the most specialized among diptera admits of no question; that it is one of the most degraded of flies is equally certain. The whale and the bat are more highly specialized animals than is the dog; but, nevertheless, they have a very inferior rank.

I have collected flies for years, and have necessarily observed their habits somewhat closely, but I have never seen anything in them that might be called intelligence. Man's claims to preëminence in the animal kingdom rest almost wholly upon his intelligence: for the same reason, preëminence among insects must be conceded to the hymenoptera.

S. W. WILLISTON.

BOOK-REVIEWS.

Lecons de Chimie, a'l'usage des Eleves de Mathematiques speciales. Par HENRI GAUTIER, ET GEORGES CHARPY. Paris, Gauthier-Villars et fils, Quai des Grands-Augustins 55 471p., Ill., 1892, 9Fr.

WE take pleasure in announcing to students of chemistry in this country the above able work of MM. Gautier and Charpy, which while designed, according to its title, particularly for students of mathematics is of highest interest to all chemists. The title is misleading to American readers as the book is in no sense a volume of difficult and complex mathematical theories as one might suppose but an extraordinarily clear exposition of the ground work or base of chemical science, mathematical in its exact and succinct statements. It is not wished to imply that chemists should avoid mathematical because they are such even though they may deal with chemical theory, but it is nevertheless a fact that the mathematical training in many of our colleges (we speak of special courses in chemistry) has been pushed to the wall. There is a reason for this, a doubtful one however, in the shortness of the collegiate course which necessarily prevents more than an introductory knowledge of chemistry even when this subject is taken alone. The main difficulty rests in the confusion of college and university and in the effort to complete one's education in the four years following the "high school" graduation.

The authors aim to present the subject to students, not as a mass of facts and recipes, but as a science which while it may be as yet more or less imperfect is already far advanced in definite form. This is particularly the purpose of the first part of the book, which deals with generalities and seeks to separate facts from principles acquired by hypothetical speculations as well as to define precisely the meaning of terms employed. A methodical and rapid presentment is made of the laws of combination, of chemical equivalence, the atomic theory, of crystallographic laws, and of thermo-chemistry. It is shown that the atomic theory, a beautiful structure in itself, might still be done away with without in any degree undermining the laws of chemical equivalents. Great pains have been taken with the second part of the book, which deals with the metalloids as is evidenced in the exactness of the facts recorded. Original memoirs have in each case been consulted and when there has been doubt or contradiction the authors have verified their decision by actual experiment. So also with those portions treating of industrial chemical processes, modern and practical usage have alone been given passing over former processes in a few words as of historic interest only. This is a relief from the custom of many authors who through lamentable ignorance deceive the student with descriptions of processes as impossible as they are false. In short the features of the work are, an eminently successful departure from accepted notions of chemical text-books, a suppression of old and hoary errors which have descended through these same text-books from our ancestors to the present day, new methods of treatment and new illustrations. Some of the French scientific periodicals have predicted for the "Lecons de Chimie" "a place among the classics which will be as lasting as it is well merited" and such praise we feel confident will be accorded by all who peruse the work. CHARLES PLATT.

NOTES AND NEWS.

ACCORDING to the State Board of Health of Michigan, the statistics of sickness have demonstrated the law that generally influenza (la grippe) is quantitatively related to the atmospheric ozone—the more ozone the more influenza; and the law that remittent fever is inversely related—the more ozone the less remittent fever. The unusual amount of ozone, the increase of influenza and the falling off of remittent fever shown in the State Board of Health Bulletin for the week ending November 18 illustrate these general laws.

—Bulletin No. 48 of the National Museum contains the collected writings upon Myriapods by the late Chas. H. Bollman. The volume is edited by Dr. Underwood, who also contributes an excellent list of the literature of the N. A. species. The writings of Mr. Bollman are given in their order as published in Entomologica Americana, Proc. of United States National Museum, and other publications, and include also many articles which were ready for the printer at the time of Mr. Bollman's death. These latter will be especially valuable to the student of N. A. Myriapods, as they include articles upon the "Classification of the Myriapoda" and a catalogue of the N. A. species. Mr. Bollman described sixty-five species new to N. A., nearly all of which will stand, and when we consider that he was not yet twenty-one years of age at the time of his death we can but regret that he was not spared for further work. The volume just published by the Museum is by far the best work on N. A. Myriapods that has appeared since Wood's paper in 1865.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A very fine telescope, length extended, twenty-five inches, closed, seven inches. Power twenty-five times. Good as new. Cost $25.00. Will sell for the best cash offer. B. S. Bowdish, Box 165, Phelps, N. Y.

For Sale or Exchange for last editions of Standard Works on Vegetable Anatomy or Physiology: Practical Zoology, Marshall & Hurst; Elements of Embryology, Foster & Balfour; Zoology, Macalister; Guide to the Study of Insects, Packard; Geological Studies and Shall We Teach Geology, Winchell. Also have duplicates of Experiment Station publications which would like to exchange for any not in my file. L. R. Jones, Burlington, Vt.

For exchange.—Skins of Aegialites nivosa, Ereunetes occidentalis, Aunnodramus Arldingi. A. rostratus, Chamara fasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diego, California.

I have a Beck New National monocular microscope, accessories, microtome, mounting material and a large number of fine slides. Will exchange the whole or in part for a first class type-writer or photograph outfit. A. C. Gruhlke, Waterloo, Ind.

Offered sidebloom eggs of Bulimus oblongus and exotic land and freshwater shells in exchange for Helices not in collection. Send lists to G. K. Gude, 5 Gresbach Road, upper Holloway, London, England.

Would like to exchange 100 specimens of Canadian Indian Relics for a photo outfit. E. J. Waters, 33 Hoffman St., Auburn, N. Y.

Wants.

A GEOLOGIST thoroughly conversant with the geology of the Southern States desires an engagement. Has complete knowledge of the economic geology of Iron, Coal, Lignite, as well as Clay and Kaolin. Five years' experience with Geological Surveys. Address K., 509 West Sixth Street, Austin, Texas.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address. stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

WANTED.—A recent college graduate to assist in editorial work on Science. Those seeking large emoluments need not apply. N. D. C. Hodges, 874 Broadway, New York.

SCIENCE

ELEVENTH YEAR.
VOL. XXII. No. 565.

DECEMBER 1, 1893.

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SCIENCE

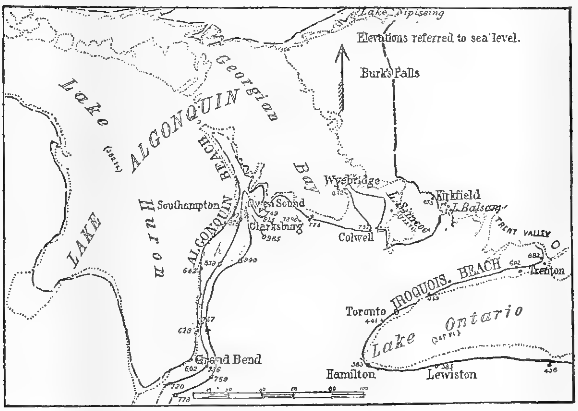
NEW YORK, DECEMBER 1, 1893.

REVIEW OF THE BIRTH OF THE GREAT LAKES AND THEIR DESERTED SHORES.[1]

PAGE after page in the history of our Great Lakes has been deciphered by the researches of Dr. J. W. Spencer. This study has involved many of the most important questions in dynamical geology. First there was the long continued high continental elevation, during which the Laurentian valley was excavated by the erosion of the great river, its tributaries and the multitudinous branches. Afterwards, the old topography became disfigured, the hills were swept off and the valleys filled up, and all the other changes of the ice age followed, with the drowning of the lower lands by the encroachments of the sea upon the sinking continent. The lands had given place to the sea; now the sea receded from rising lands. In the olden days, the mountains had been worn down to mere trunks, but with the pleistocene re-elevation which lifted the later shore-lines the old water-levels were deformed and broken. In our issue of June 3rd, 1892, we described the manner in which the lake basins had been formed—just ancient valleys closed by drift and by the warping of the earth's crust in proximity to some of their outlets. Then the history of these fresh-water lakes began. Fragments of their story have now been discovered, and their well preserved but deserted beaches mark the shrinkage of the waters.

About the close of the ice age, one great sheet of water covered most of the Great Lake region, occupying 200,000 square miles or more. This was Warren water, whether salt or fresh is not yet known. Its shores upon both sides of the Superior basin, about Lake Michigan and Lake Huron, on both sides of Erie, in Ontario and New York, are now more or less known, but not the northeastern limits. This is an enormous area for only three or four workers to cover: nearly the whole region by the author under review; New York and Ohio by Mr. G. K. Gilbert; north of Lake Superior by Dr. A. C. Lawson; about Lake Michigan, south of Superior and northeast of Lake Huron by Mr. F. B. Taylor,—this makes our list of workers.

From one strand to another, lower, lower, lower sank the Warren waters, and slowly rose the deserted shores of the great inland sea or lake. But this subsidence of the waters was caused by the rise of the land; not an equal uplift of the continent, but a greater elevation towards the north and east than towards the south and west. The lands about the shrinking lakes were gradually expanding, so as to eventually dismember the Warren water, when it was contracted within the separate basins. At first there were two of these. The greater was Algonquin Lake, covering most of the Superior basin, reaching to near the southern end of the Michigan, to near the southern end of the Huron, and expanding far beyond the eastern margin of Georgian Bay, and extending by a strait northeastward toward the Ontario basin by way of the Nipissing and Ottawa valleys.



MAP SHOWING THE EASTERN PART OF ALGONQUIN LAKE.

The other branch of the dismembered Warren water was an unnamed union, embracing the waters in the Ontario basin and in the Erie basin, to the extent perhaps of a hundred miles from the Niagara River.

The waters at the level of the Algonquin and the lost pre-Erie beach tarried for a long period; but from these levels they gradually sunk, leaving fainter beaches and terraces until a level 300 feet below was reached—the Iroquois beach

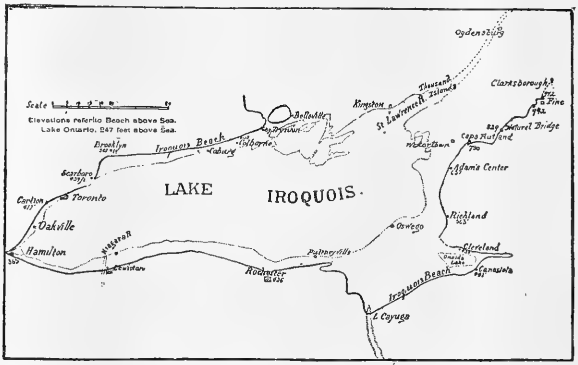
Then Niagara River had its birth. At this level, the

[1] "Deformation of the Iroquois Beach and Birth of Lake Ontario." Am. Jour. Sc., Vol. XL., 1890.
"Deformation of the Algonquin Beach and Birth of Lake Huron."
"High-Level Shores in the Region of the Great Lakes and their Deformation." Am. Jour. Sc., Vol. XLI., 1891.

pause in the terrestrial movement was of long duration. The youthful Niagara drained only the Erie basin, and cascaded over the low Niagara escarpment in a sheet resembling the modern "American Falls."

After a long rest, the continental undulations again became active, so that before long the waters in the Ontario basin sank eighty feet below its present level, and withdrew somewhat from the head of the lake, but they extended far down the Laurentian valley.

The Iroquois shore was formed at sea level. Before the Iroquois episode, the terrestrial warpings had set in, but the deformation was relatively slight. The deformation accompanying the epeirogenic movements following the Iroquois days was much more pronounced. About the head of Lake Erie, the beaches are now nearly level, but at the eastern end the deformation is two feet in the mile; east of Georgian Bay it amounts to four feet, and east of Lake Ontario it reaches five, six or even eight feet or more in each mile. In this Adirondack region, it is not unlikely that the old strands have been more or less dislocated by modern faultings such as occur from the Hudson River southward. Up to the present time we do not know what barriers, if any, closed these inland seas. The lower strands are known to be connected with old marine shore-lines. There may have been some land barriers now unrecognized on account of faulting. Some think that the waters were held in as glacial lakes. Of the eastern region there has been too little exploration for us to know anything about the lakes. But we do know that there were once greater bodies of water where the lakes now exist.



MAP SHOWING THE WESTERN PART OF IROQUOIS LAKE.

During the earlier Niagara epoch, or throughout the Iroquois epoch, the Nipissing strait became lower, and the Algonquin waters slowly subided so that they emptied by a river flowing through the Nipissing basin and the Ottawa valley to the Iroquois lake below. But with the rise of land accompanying the subsidence of the Iroquois waters, below their great beach, the Nipissing rim of the Huron basin was raised so high that the Algonquin lake flooded the head of the Michigan basin, and overflowed what is now the outlet (then the head) of the Huron basin, and drained by the Niagara River.

About this time the eastern rim of the Erie basin was raised up, so that the waters backed up to the present head of the lake, and the barrier at the outlet of Lake Ontario was uplifted so as to back water over the lands at the head of the basin to the extent of eighty feet.

To-day the Iroquois beach rises 363 feet above the sea (the lake is 247 feet). At the eastern end the same beach is 730 feet, and still farther, on the flanks of the Adirondack mountains, this old shore line may be seen in fragments at a thousand feet or more, the whole rising as a monument of the mutability of the most ancient hills of America.

The story of the lakes is still incomplete, and some of the most important questions are not yet settled. But a dozen years of research upon the old shore-lines, whether beaches, terraces or sea cliffs, has begun to throw some light upon the history of the most distinguished feature of the continent. We now know something of the origin of the basins, the birth, maturity and commencement of the old age of the great lakes. Something more of their age will be known when the history of Niagara Falls is written, but its history could not have been deciphered without the present history of the lakes being known.

—At the beginning of the present year a meeting was held in London to promote a memorial commemorative of the eminent services of the late Sir Richard Owen in the advancement of the sciences of Anatomy, Zoölogy and Palæontology. It was decided that the memorial should consist primarily of a marble statue, which should be offered to the Trustees of the British Museum, to be placed in the Hall of the Natural History Museum. A large committee, including the names of many foreign and American men of science, was formed to carry out this project, the Prince of Wales being Chairman. The circular-letter sent out has been very liberally responded to, the subscription list amounting on Nov. 1 to £1,050. The number of contributors, however, is relatively small; and it is hoped that a much larger sum will yet be obtained: for Owen was so many-sided in his work that his memory has a claim upon naturalists of every grade all over the world. With a few notable exceptions, a very small number of American names have as yet appeared among the contributors. They have probably yet to be sent, and we would offer the present suggestion that subscriptions from intending donors should be sent with as little delay as possible to the Treasurer of the Fund, Sir William H. Flower, Natural History Museum, London, S. W.

—T. Y. Crowell & Co. have received word that Professor Ely's "Taxation in American States and Cities," published by them, will soon appear in Japanese, the work having been translated by Dr. Iyenaga, one of his former students, and Mr. Shiozawa. Messrs. Crowell & Co. hope to have Professor Ely's new book on "Socialism" on the market in the coming spring.

—James Pott & Co. announce that they have made arrangements with Prof. Henry Drummond to bring out his new work, "The Evolution of Man," being the Lowell lectures for 1893.

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TEXAS CLAYS AND THEIR ORIGIN.

BY W. KENNEDY, AUSTIN, TEXAS.

A SHORT time ago, while engaged in making a report on the clays of the State for the Geological Survey of Texas, I had occasion to study a large number of analyses made of clays belonging to the different Tertiary formations. During the course of the investigations it appeared to me that there was a peculiarity in the chemical composition of these clays not often seen among clays—that is, while in nearly every other clay to the analysis of which I had occasion to refer, and in which the alkalies, potash and soda were separated, the contained potash appears to exceed the percentage of soda, and in some instances this excess appears to be very great. In the Texas Tertiary clays, on the other hand, almost every one of the analyses made shows the soda to exceed the potash in ratios from 2 to 5 of soda to 1 of potash. As this excess varies in the different divisions, the difference generally increasing as we ascend in the beds, while at the same time the actual quantities of both decrease in the same ratio until the highest or coastal clays are reached, when the amounts of both are largely increased, I have been led to the opinion that this peculiarity might be due to the origin of the materials forming these deposits, or that some clue to their source might be obtained by a study of this phenomenon.

With this object in view, I have examined whatever analyses have been available of the deposits underlying or older than the Tertiary within the State, as well as the analyses belonging to the Tertiary and other beds found in the other States, so far as I have been able to obtain them, together with the analysis of the underlying deposits from which the clays may reasonably be expected to have been derived.

In the New Jersey clays, which, according to Cook, are of Cretaceous age and derived mostly from rocks lying to the southeast of the deposits, but which are now covered with water, or else completely destroyed, the percentages of potash and soda are 0.93 potash and 0.10 soda. In Ohio, according to Mr. Orton, the clays derived from the Carboniferous shales show averages of:

	Potash.	Soda.
5. Fire clays,	0.67	Traces
8. Potters' clays,	0.91	Traces
6. Pipe clays,	2.82	0.26
Or an average of	0.18	0.0137

In Kentucky, the next report examined, Dr. Peters shows the averages of the different formations to be:

	Potash.	Soda.
10. Tertiary fire clays,	0.607	0.099
17. Coal-measure fire clays,	0.537	0.407
5. Tertiary Potters' clays,	0.814	0.208
3. Coal-measure Potters' clays,	2.009	0.231
3. Black slate and Clinton clays,	4.537	0.303
1. Middle Hudson clays,	4.660	1.706

In Arkansas, according to Williams, the shales show the percentages of potash and soda to be:

	Potash.	Soda.
At Little Rock,	1.36	2.76
Round Mountain,	1.81	0.66
Fort Smith,	2.18	1.03

These shales belong to the Carboniferous, and it may be noted that the shales in the neighborhood of Little Rock are in close contiguity to the syenite area around Fourche Cove. Unfortunately no clay analyses showing the exact relations between the potash and soda in the Tertiary deposits are available from either Arkansas or Louisiana, into which many of the Texas Tertiary beds stretch with unbroken continuity.

Coming back to the fact that the Texas Tertiary clays are sodic clays, it is interesting to note that the immediately underlying deposits of Cretaceous age also carry an excess of potash over soda. The section of these beds appears to be roughly, in descending order, thus:

Greensand marls,
Marly flags,
Ponderosa (blue) marls,
Chalk marls,
Austin limestone.

The published analyses of these deposits show the percentages of potash and soda to decrease as we descend as follows:

	Potash.	Soda.
Greensand marls,	1.75	2.94
Ponderosa (blue) marls,	0.802	2.78
Chalk marl,	0.15	2.84
Austin limestone,	0.23	2.34
Average Cretaceous,	0.733	2.72

Going still further back in the deposits, the only analyses we have of the clays and shales of the Carboniferous show them to be also sodic and to carry a percentage of 3.09 soda and 1.53 potash, or closely approximating the ratio shown in the Tertiary basal clays and the lignitic beds.

The only analyses we have of the Texas kaolins show the west Texas materials to be practically free from alkalies and the Edwards County deposits to carry 0.02 of potash and 0.60 soda. An analysis of the basalt from Pilot Knob, near Austin, gave Professor Kemp 2.77 soda and 2.02 potash (*Amer. Geol.*, Nov., 1890). A kaolin from Pulaski County, Arkansas, shows 0.23 potash to 0.37 soda.

Clays naturally partake of the nature of the rocks from which they may have been derived, and the proportions of their constituents will in the same manner be in a ratio more or less in accordance with those of the parent rock, the variations being due to the solubility of the constituent and the number of changes to which it may have been subjected during the course of its transportation from the original locality to that in which we may find it. These changes are, however, sometimes extremely great, as, for instance, in the case of kaolin. Williams shows a kaolin in Arkansas, evidently derived from a syenite containing 5.48 potash and 5.96 soda, to have only 0.23 potash and 0.37 soda.

Since, then, the Texas Tertiary clays appear to be sodic, where are we to look for their sources? Are they due to the destruction of the syenites of Arkansas or the basaltic outbreaks of which Pilot Knob is a representative, or must they be traced to a still more remote source among the eruptive and intrusive rocks of western or central Texas through the media of the Cretaceous, Carboniferous and other stages found in Texas?

Another question may be asked. The Tertiary deposits themselves give strong evidences of their being mostly of marine deposition, having throughout the greater portion of them a marine fauna. Had this condition of deposition anything to do with the quantities of soda found in the beds? Was it deposited from the waters of the sea and afterwards absorbed by the clays? Sodium chloride appears as an efflorescence in many portions of the area. Sodium occurs both as chloride and sulphate in nearly the whole of the mineral waters examined, and even the Greensand marls of the marine beds show, with but few exceptions, a large percentage of soda over the potash.

The few soils examined by the officers of the Geological Survey have also the same apparent constitution. Soda appears to exceed the potash.

It may also be of interest to find that, according to Ditmar, the relation of soda (Na_2O) to potash (K_2O) in ocean water is 100 to 3.23, and in kelp, according to Richardson, 100 to 5.26.

For geological purposes, the Texas Survey has divided the Tertiary deposits into five divisions, which may be briefly described, in ascending order, as follows:

First: The basal beds or Wills Point clays—This is a series of blue, bluish gray, yellow and brownish yellow clays, and gray, yellow and brown sands. These clays contain numerous small nodules of calcareous material, and crystals of selenite also occur in places. They also appear as fossiliferous in places. Boulders of fossiliferous limestones, with veins of calcite through them, occur scattered throughout the beds, although the heaviest proportion belong to the yellow-sand division—and occasional irregular deposits of heavy bedded white and grayish white highly fossiliferous limestones form a portion of these basal beds. These deposits lie immediately upon the marly deposits of the Upper Cretaceous, and may be said to have been deposited in small bay-like indentations along the Cretaceous shore line, or probably have suffered extensive erosion, as they now occur only as isolated patches in a few places along the Cretaceous border.

Second: The lignitic beds.—These deposits form the lowest portion of Dr. Penrose's Timber Belt beds and comprise a series of blue, brown, yellow, white and gray clays and sands, with extensive deposits of brown coal and lignite. The clays occur as thinly laminated, or stratified and massive, sometimes nearly free from sand; but the greater portion occurs as sandy or micaceous clays. Near the base these deposits consist of blue sands and clays, with occasional beds of gray and pinkish white or gray clays and thin deposits of brown sandstones. At the top they become a series of thinly-laminated and thinly-stratified red and white sands and clays, the laminæ or strata usually not exceeding ¼ to ½ inch in thickness, although the white-clay strata occasionally form beds from four to six feet in thickness. These, however, are very irregular, and when such a thickness of clay occurs it generally forms a pocket-like deposit extending over but a small area. The intermediate beds may be said to be blue and dark gray sands, clays and lignites—the lignites often attaining a thickness of from six to sixteen, and even more, feet. These lignite beds are probably the most extensively developed Tertiary deposits within that portion of the coastal plain in the State. Nor are they confined to Texas alone, but occur farther east in both Arkansas and Louisiana. In the northeastern portion of the State they have a known thickness of 1,000 feet, wells bored in that region from 800 to 1,000 feet having failed to pierce them; and at Mineola, in Wood County, the base of these beds was not reached in a well 1,200 feet in depth. These beds contain vast deposits of clays of all sorts, including plastic potters' clay and refractory clays showing an analysis equal to the best Stourbridge, as well as clays suitable for the manufacture of the finest grades of porcelain.

Third: The Marine beds.—Succeeding the lignitic beds and overlying them in direct continuity comes a series of sands, clays and iron ores, the greater portion of which is highly fossiliferous, containing in many places an abundant marine fauna. These beds have an aggregate thickness of over 600 feet. Abundant deposits of limonite and greensand marls occur throughout them, but the clays are generally poor and very irregularly deposited.

Fourth: The Yegua beds.—The fourth great division has been called the "Yegua clays" from their development on the river of that name. These clays form the base of Dr. Penrose's Fayette Beds, and the division comprises a series of dark blue and gray clays and brown and gray sands and sandy clays, with great quantities of selenite in crystals from nearly six inches in length down to sizes almost microscopic. The water found in these beds is strongly saline, and in many portions of the area underlaid by them, especially where the dark blue clays approach the surface, the gray overlying sands show patches of saline efflorescence. Many of the gray clays belonging to this series contain leaves and stems of plants, and heavy deposits of lignites also occur at many places within the same area.

Fifth: The Fayette Sands.—This division has been called the Fayette Sands chiefly on account of its being made up largely of gray sands and sandstones, although, however, it contains many deposits of very fine white and gray clays, many of which when washed showing decided kaolinitic conditions. These deposits are also more or less fossiliferous, showing at places a scanty marine fauna of the Eocene series, and closely connecting them with the yellow and brown sands of the marine beds already referred to. In the sands belonging to this division great quantities of beautifully opalized wood occur. Beds of a very fine white silicious earth or sinter occur at several places within this area, and the enormous quantities of gray sandstone used at Galveston and Sabine Pass for jetty purposes are obtained from these beds. Many of the clays and coarse sandstones belonging to the upper portion of the Fayette beds are highly calcareous, and in places show small quantities of well-worn Cretaceous shells.

Overlying the Fayette sands there appears a series of heavy-bedded, blue, red, green and yellow and sometimes white clays, with brown and grayish white sands containing small patches of pink clay. These are pretty generally ascribed to the Tertiary age, but their exact position is as yet a matter of doubt. The blue clays contain an abundance of calcareous nodules scattered throughout them, although these nodules appear to be wanting in the immediately underlying red clays, and are not very plentiful in the overlying yellow and green deposits. These deposits have not yet received a specific name. They have been described in the Third Annual Report of the Survey under the title of the Fleming beds. Since then, however, more extended research has been made in these beds in southwestern Texas, and Mr. Dumble proposes to assign to the whole division the name of "Frio Clays."

The last division of our clay deposits is known as the Coastal Clays. These occupy an area of from 75 to 100 miles in width along the coast, and comprise a series of blue, brown, yellow and variously colored clays, many of which are highly calcareous.

With probably the exception of the basal beds, which, as has already been stated, appear to be somewhat irregularly distributed along the contact between the Tertiary and the underlying Cretaceous, the whole of these deposits may be considered as lying in a series of irregular belts roughly parallel to the present coastal line, while a section drawn across them almost anywhere would show each to have an abrupt exposure towards the northwest. In other words, while the dip is approximately southeast, the northwestern edge appears usually as an escarpment showing the broken ends of the beds, and in places these escarpments have deflected the courses of several of the rivers crossing the Tertiary area. These rivers also appear to be working southward, showing high steep bluffs along their southern sides, while broad flat bottom lands appear along their northern banks. Such also appears to be the course of operations with all the larger streams running in an easterly or westerly direction.

A peculiarity noticeable among the lower divisions of these deposits is a flexing or bending of the beds, beginning in the lignitic, and, so far as at present known, reaching the culminating point towards the top of the marine beds. This flexing has resulted in making many of the higher hills hills of erosion and the tops portions of the synclines.

From this brief outline it will be seen that the greater portion of the Tertiary areas is made up of extensive beds of clays and sands.

The analyses of these clays made by the different chemists of the Geological Survey show them to have the peculiarity of having the proportions of the alkalies potash and soda reversed. In the greater number of clay analyses which I have had occasion to refer to, the proportion or percentage of potash exceeds that of the soda. In the Tertiary clays of Texas the proportions of soda exceed the potash as 3.19 of soda to 1.18 of potash. These proportions vary in the different stages, as will be seen in the following:

	Potash.	Soda.
1. Basal beds,	1.53	3.64
2. Lignitic beds,	1.35	3.42
3. Marine beds,	0.91	2.32
4. Yegua beds,	1.07	2.33
5. Fayette beds,	0.67	1.93
6. Fleming (Freo) beds, no analyses made.		
7. Coastal clays,	1.56	5.52

From this it will be seen that there is a gradual decline of the two alkalies as we ascend until the coastal clays are reached, when the soda shows a sudden increase over the basal beds almost equal to the sum of the losses it sustains in the other members of the series, while its actual increase over the Fayette beds amounts to 3.55. The potash also shows an increase in these beds over the basal clays of only 0.03, and over the Fayette beds of 0.88, or about equal to the sum of the losses sustained in its course through the deposits from the lignitic to the Fayette.

The question of the origin of these clays involves the existence of an extensive land area of deposits in which the alkalies were strongly represented, and, assuming the solubility of the two to be approximately similar (as a matter of fact the potash is slightly more soluble), one in which the soda was considerably more abundant than the potash. Again, throughout the deposits and interbedded with the clays we have heavy beds of sand, many of them almost pure quartz, and the greater portion of the clays themselves are highly silicious. In addition, the immense deposits of limonite found interstratified with and covering the marine stage of these deposits will require to be accounted for.

It appears to me that the most probable immediate sources of the materials entering into the composition of these Tertiary deposits are the underlying cretaceous beds for the lowermost or basal Tertiary, and a partial reworking of the older Tertiary with the cretaceous materials for the upper or newer deposits. These cretaceous marls and marly clays correspond very closely to the Tertiary deposits, as will be seen from the following analyses:

	I. Av. of 59 Tertiary Analyses.	II. Av. of 8 Cretaceous Analyses.	III.
Silica,	65.63	31.67	59.34
Alumina,	14.84	9.92	18.59
Iron,	4.83	3.36	6.30
Lime,	3.19	26.68	3.19
Magnesia,	0.30	Trace	Trace
Potash,	1.03	0.73	1.37
Soda,	2.65	2.72	5.01
Carbonic acid,	——	20.95	——
Sulphuric acid,	0.57	1.04	5.67
Water and loss,	7.11	2.97	.57
	100.15	100.04	100.04

The third column shows the average of the Cretaceous analyses re-calculated without the carbonate of lime and carbonic acid and omitting a portion of the sulphuric acid, which would undoubtedly be lost during the course of erosion and deposition, and which we might expect to find farther to the south among the more recent of the Tertiary deposits as well as in the coastal clays. The percentages of lime and sulphuric acid shown in this analysis are the averages shown in the Tertiary deposits. The course of the lime through the different sets of beds appears to be thus:

Basal beds,	2.05
Lignitic beds,	0.77
Marine beds,	1.97
Yegua beds,	0.43
Fayette beds,	10.75

Many of these Fayette clays contain as high as 24.42 per cent of lime and 18.91 per cent of carbonic acid. Among the sandstones belonging to the upper division there are many beds which might be classified as calcareous sandstones, some of them containing enough lime to have made it profitable at one time to use them as a source of lime for building purposes. Their derivation from Cretaceous deposits is also indicated by the existence of numerous water-worn Cretaceous shells.

The coastal clays contain immense quantities of lime at different points, and nothing short of an immense number of analyses could give us anything like a fair average. They have not been included in any of the above analyses.

The basal beds of the Tertiary so strongly resemble the upper and contiguous beds of the Cretaceous in lithological as well as chemical structure that it is very difficult to tell them apart, and in many portions nothing but a study of the fauna will enable anyone to differentiate the two, and in many places the Tertiary beds contain boulders and fragments of Cretaceous limestones containing Cretaceous fossils.

It would thus appear that the structural conditions of the Basal beds and the Fayette deposits, apart from any chemical evidence whatever, bears out the assumption of these two divisions being derived from the Cretaceous. If we accept Dr. Penrose's theory that the iron ores and glauconite of the marine beds are largely due to the destruction of the upper glauconitic division or the greensand of the Cretaceous, and in this theory, from a long period of work among these beds, I am inclined to believe for several reasons—one of which being the close affinity chemically and otherwise of these beds. Then that will in a great measure dispose of the origin of the middle great division.

Now whether the great series of deposits immediately overlying the marine beds—the Yegua clays—have been altogether derived from the erosion and consequent destruction of the marine beds is not very clear. That a portion of the materials composing these clays was so derived there can be no doubt. The line of contact between the two is very irregular in more than one place, showing long troughs or valleys of erosion in the older beds, and now filled up by the clays and sands of the newer. At other places this outline shows the existence of comparatively bold head-lands, from which no doubt the waters of Yegua time abstracted a considerable quantity of material. The presence of extensive deposits of lignites in these beds would appear to indicate another source of material having a swamp or lagoon origin, and some of it may have been obtained from the rivers traversing the region. Some of the materials employed in the formation of these beds may also have been derived from the sea water occupying the area during the period of deposition.

The last division, or more properly speaking, the second division—the lignitic beds—presents somewhat different features from any of the others. So far as it contains immense deposits of lignite and small beds of sand carrying crystals of selenite, it resembles the Yegua clays, but with that its resemblance ceases. The beds belonging to this division overlie the basal deposits, which in many places they overlap so completely as to obscure them altogether, and in others lie in direct contact with the Cretaceous deposits. Throughout the whole of the immense thickness and extent of these beds, with the exception of a few fragmentary plant remains, some of them belonging to the *sabal* family, not a single fossil is known from this division. Evidently the conditions were not favorable to animal life.

These beds apparently represent a period when the whole coast was made up of swamps, lagoons and bayous, very similar to some portions of the gulf coast of the present day, or what may be seen in the broad stretches of overflow or "bottom" land found along almost every one of our rivers. A rank vegetation grew on the marshy portions, and the rivers of the time having no fixed channels, distributed their waters throughout the lagoons and bayous and into them, and over the low islands carried their burdens of debris during periods of flood. With this debris came soft clay, sand, branches, limbs and trunks of large trees, all of which went to swell the accumulations already gathering and aid in the formation or the lignites and their associated beds of clay and sand. In the meantime the coast was slowly sinking and the encroaching water eating away the basal clays and the Cretaceous deposits within reach.

The lithological structure of these deposits accord with these conditions. Everywhere the deposits are irregular in deposition, variable in texture, changing from fine-grained, dense, muddy, to coarse-grained, sandy material within short distances. Many of the beds contain great quantities of iron pyrites, a common characteristic of the Cretaceous greensand marls. In composition these lignitic beds closely resemble these marls.

	IV. Av. of 38 analyses of lignitic clays.	V. Cretaceous greensand marls.
Silica,	69.83	60.82
Alumina,	16.93	16.05
Iron,	3.66	5.25
Lime,	0.77	3.66
Magnesia,	0.35	
Potash,	1.35	1.75
Soda,	3.42	2.94
Sulphuric acid.	0.22	1.06
Carbonic acid,		2.85
Water and loss,	4.26	5.53
	100.79	99.91

From this, then, it would appear that while the greater portions of these clays and sands are derived from Cretaceous materials, these have been mixed with a small quantity of ingredients belonging to some of the older formations through which the larger rivers ran; but the proportions of these older materials were so small as not to visibly affect the deposits as a whole.

Mention has been made of the syenitic rocks of Arkansas and the basaltic outbreaks extending through the Texas Cretaceous area as forming the source of some of the materials found in the clays. These I do not think can have contributed any of the materials required. No very decided evidence of the age of these rocks has been given, but the general opinion as stated by Branner and Williams appears to be that the age of the Arkansas rocks is ether late Cretaceous or early Tertiary, and certainly not newer than this time. According to Hill, Pilot Knob belongs to the upper Cretaceous and the latter half of Austin Chalk sub-epoch. If these ages are accepted, then certainly the rocks in question had nothing to do with the formation of the Texas Tertiary clays.

KARYOKINESIS IN EMBRYOS OF THE DOMESTIC CAT.—PRELIMINARY NOTICE.

BY FRANK S. ABY, HISTOLOGICAL LABORATORY, STATE UNIVERSITY OF IOWA.

In all sections of various embryo kittens that have been examined by the writer, up to those of embryos seventeen millimetres in length, karyokinetic figures are by no means an occasional or a rare occurrence, but are to be found in many situations.

In the preparation of these sections, no special cytological methods were employed, as the subject of investigation was the development of the central nervous system of the cat. The embryos were hardened in increasing strengths of alcohol, with no precautions whatever with regard to fixation. After remaining in 95 per cent alcohol for a number of months the embryos were imbedded in celloidin and sectioned. The sections were then stained in Grenacher's haematoxylin and mounted in Canada balsam.

The resting nuclei are spheroidal occasionally, but the more usual form is that of an elongated oval. Occasionally very peculiar, irregular nuclei are found, and one was seen whose length was three times its width, without the aggregation of chromatin to be described later, but with a clearly marked reticulum and nuclear membrane. Usually the nuclear membrane is not shrivelled or wrinkled in hardening, but is plump and distinct, clear cut on its outer line, and in almost all cases has taken a deep stain.

The chromatin in these resting nuclei is disposed in a reticulum that strongly reminds one of the bridles seen in plant cells. This reticulum is clearly continuous with the nuclear membrane, as may be seen in very numerous instances, the point of union of a strand and the nuclear membrane presenting a well-defined enlargement of the strand. In some nuclei which happen to lie in the proper position several of these points of union in a single nucleus appear in the same plane, giving the nuclear membrane the appearance of being toothed.

Occasionally a nucleus is found in which all that is to be seen within the nuclear membrane is this reticulum, without local aggregations of the chromatin. In the greater number of nuclei the chromatin is so disposed that certain local thickenings may be observed. Under a power of about 500 diameters these accumulations of chromatin appear to have no connection with the nuclear membrane, but each nucleus seems to have a well-defined nucleolus. Under a power of 1,200 diameters, however, the connection between the strands of the reticulum and this central body stand out clearly. This aggregation of chromatin may be condensed, and in some instances may be described as spheroidal; in other more numerous instances it is elongated, and, with its radiating strands of the reticulum, looks very much like a bone lacuna, with rather coarse canaliculi. Usually but one such body is found in a nucleus; but occasionally there are two side by side, or both near the nuclear membrane, and it is not rare to find four or five. From the behavior of these local aggregations and the strands of the reticulum to haematoxylin, it is not possible to determine a difference. Both have about the same tint, and any slight difference of shade may be attributed to the quantity of colorable matter present in the aggregations.

In situations where it is to be supposed that cell multiplication is proceeding rapidly, as in the Wolffian bodies and the inner lining of the cerebral vesicles and central canal of the developing cord, many nuclei are found whose nuclear membranes are indistinct, in many cases invisible. Those nuclei, however, are quite conspicuous, owing to the fact that the chromatin is no longer disposed in thin shadowy strands, but is in heavy solid skeins, taking a much deeper stain than any part of the resting nuclei. Moreover, these deeply staining bodies of chromatin in these nuclei assume the position of the nuclear membrane that has disappeared, thus forming a basket with irregular meshes. Thus far I have not been able to determine whether in these nuclei it is a single skein, or a number of segments, that enter into the formation of this basket; but in certain nuclei, where the basket was not very regular, detached segments were certainly determined. In some nuclei in which mitosis was well established the loops of chromatin, or chromosomes, were seen scattered through the nucleus, as if the basket had been broken into fragments and crushed in. No traces of the nuclear or achromatic spindle were observed before the monaster stage.

The monaster stage was seen in many nuclei, but the best view was always obtained when the achromatic spindle was lying at right angles to the line of vision. When the aster was seen from the pole the chromosomes were in such a tangle that no satisfactory view was obtained. In the nuclei of embryo kittens the chromosomes are short and thick, and in the haematoxylin employed took a very deep stain, in many cases almost black. For these reasons it was usually impossible to distinguish individual chromosomes in either the monaster or dyaster stage, but the ends of the chromosomes were usually distinct.

The achromatic spindle at this stage is fairly conspicuous and well defined. The chromosomes are seen clustered in the plane of the equatorial plate, while on both sides the fibrils of the achromatic spindle converge toward the pole corpuscle. From the region surrounding the pole corpuscles, radiating out into the cytoplasm, are to be seen the exceedingly delicate rays of achromatic substance, forming the polar cones. Many nuceli were seen at this stage presenting the appearance of the conventionalized diagrams, such as Quain's "Anatomy," tenth edition, vol. I., part II., figure 214, except that the chromosomes were not so distinct as in the diagram.

In the process of metakinesis all phases were seen, from that in which the limbs of many chromosomes remained in contact, while the apices of the loops had separated, to the complete dyaster stage. In some instances the ends of the limbs of two or four chromosomes remain in contact, the others having separated. In nuclei in which the two sets of chromosomes have migrated for some distance, and are separated by an interval equal to the average diameter of a resting nucleus, the exquisitely fine webs that stretch from the ends of the limbs of one set to the ends of the limbs of the other set may be seen in many instances. When the two sets are separated by a small interval the web is not easily seen.

In the dyaster stage the two sets of chromosomes do not present the appearance that is usually represented. As stated before, the chromosomes of the cat are short and thick, and the limbs do not extend in such a way as to make it easy to determine their number. It is stated that the nuclei of each species contain a definite number of chromosomes. From what can be determined in the nuclei under observation, each set of chromosomes in the dyaster stage contains four chromosomes, although it is difficult to determine this point with certainty.

The portion of the achromatic spindle between the pole corpuscles and the two sets of chromosomes can be made out easily, as the delicate webs are quite conspicuous in the dyaster stage, and seems to take a deeper stain in many instances than in the monaster stage. I am not certain that the webs of the spindle react to haematoxylin, but am certain that in some instances this seems to be the case. The radiating webs beyond the pole corpuscles, extending out into the cytoplasm and forming the polar cones, have not been made out in the dyaster stage.

The chromosomes in the two-daughter nuclei, then, assume the basket form. The baskets found in the two-daughter nuclei are easily distinguished from the basket in the initiatory stage of karyokinesis by the fact that daughter nuclei occur in pairs, and each basket is much smaller than that found in the mother nucleus. The meshes in daughter nuclei are also much smaller, and the chromatin is in a close tangle.

Of all the stages of karyokinesis in these nuclei, the dyaster stage is most conspicuous and most easily found. Mitotic figures are most abundant in embryos about five millimetres in length; in older embryos they are not so easily found. In examining sections from a five-millimetre embryo, some fields show karyokinetic figures in fully half the nuclei.

In these embryos karyokinesis was observed in the following situations:

I. Lining of primitive cerebral vesicles. Here they were most abundant. Nuclei bounding the cavity showed the figures especially well.

II. Lining of central canal of the spinal cord. Here also very abundant.

III. Lining of lumina of tubules of Wolffian bodies. Occasional.

IV. Epithelium lining the pharynx.
V. Within the branchial arches.
VI. Epithelium lining the branchial clefts.
VII. Optic vesicles.
VIII. Otic vesicles.
IX. Epiblast forming epidermis of face.
X. Walls of heart.

THE PTERYLOGRAPHY OF THE PILEATED WOODPECKER (*CEOPHLOEUS PILEATUS*).

BY HUBERT LYMAN CLARK, PITTSBURG, PA.

A recent examination of a pair of Pileated Woodpeckers (*Ceophloeus pileatus*) from West Virginia showed that in several important particulars this species differs in its pterylosis from any of the plates which have been published hitherto, illustrating Picine pterylography. So far as I can learn the pterylosis of Ceophloeus has never been described, or at any rate figured, and so I venture to offer this contribution to a little known branch of ornithology. Nitzsch has figured, in his "System der Pterylographie," *Picus viridis*, and Dr. R. W. Shufeldt has figured and described (*Auk.*, April, 1888) *Dryobates V. harrisii* and *Sphyrapicus V. nuchalis;* but I have seen no other illustrations of the Pici. I have examined *Dryobates pubescens, Centurus caroliniensis* and *Colaptes auratus*, but Ceophloeus differs from all these in several ways. A comparison of Fig. 1 with the figure of *P. viridis* (Sys. Pter., Plate V, Fig. 14) shows two very important differences; one of these is on the chin and lower mandible, the other is at the opposite end of the body near the anus. The whole lower surface of the head in *P. viridis* seems to be fully feathered, while in Ceophloeus there are very distinct apteria along the

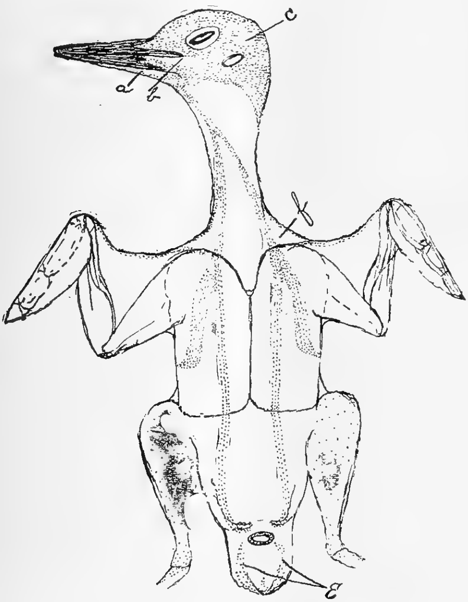

Fig. 1.—Ventral Surface of Pileated Woodpecker (Ceophloeus pileatus).

rami of the lower mandible and on the cheeks. These apteria are not shown in any of Dr. Shufeldt's figures, nor have I observed them in any other woodpecker; but they are very evident in both sexes of Ceophloeus. Fig. 3 shows them nearly natural size; *a*, the apteria of the rami, and *b*, the apteria of the cheeks; the same in Fig. 1, *a* and *b*. Nitzsch says, in regard to apteria on the head, after mentioning the temporal space (see Fig. 1, *c*) and the vertical space (Fig. 2, *d*), "Die übrige Kopfläche ist dicht befiedert," but he seems to have been wrong. According to the same writer, in *P. viridis*, the main branches of the pt. ventralis continue beyond the vent, including it, to the very base of the rectrices; but in Ceophloeus they curve abruptly inward and end just before reaching the anus, while behind the latter is a horse-shoe shaped tract (Fig. 1, *e*) which is also shown in Dr. Shufeldt's figure of *D. v. harrisii* and to which he gives the name of "post-ventral tract" (pt. postventralis). This tract is found in all the four genera of woodpeckers which I have examined, but Nitzsch does not speak of it, although he gives *P. auratus* and *P. carolinus* as among the species he studied. It seems to be wanting in Sphyrapicus, as it is not shown in Dr. Shufeldt's figure of that species. The remainder of the ventral

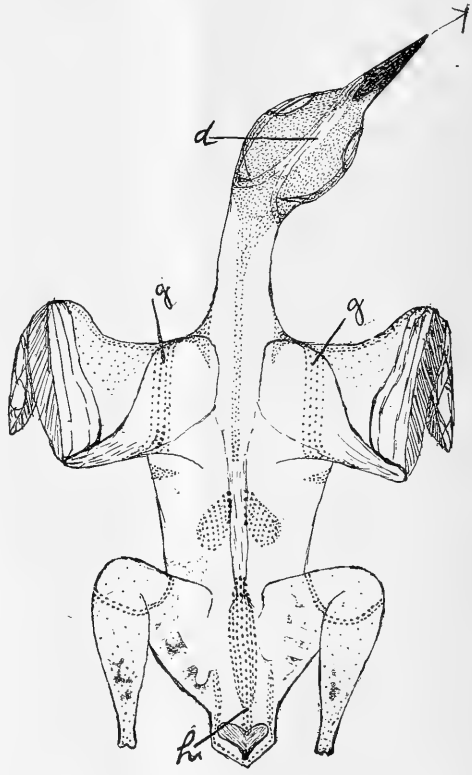

Fig. 2.—Dorsal Surface. Pileated Woodpecker (Ceophloeus pileatus).

surface of Ceophloeus agrees very well with that of *P. viridis*, especially in the connections of the pt. ventralis with the pt. humeralis and pt. alaris forming the triangular apterium shown at *f*, Fig. 1.

On the dorsal surface Ceophloeus agrees with *P. viridis* more nearly than with any other species. The only differences of note are in the humeral tracts and at the extreme end of the dorsal tract. According to Nitzsch's plate, the humeral tracts are much broader anteriorly, but in Ceophloeus (Fig. 2, *g*) they consist of four rows of contour feathers throughout, and so are of equal width at the ends. In *P. viridis* the dorsal tract is of greater width at its end on the oil-gland than it is further forward, while in Ceophloeus it is much narrower there (Fig. 2, *h*). The dorsal surface in Colaptes is on much the same plan, but the tracts are broader, and there are some noticeable differences. The tail, as is usual in woodpeckers, consists of twelve rectrices, of which the middle pair are the longest, and the outer pair are not only very short, but they are inserted almost over the pair next to them, and are much less stiff and pointed than the others. On the wing I found ten primaries and eleven secondaries and four feathers in the alula. Of the secondaries the first seven are of

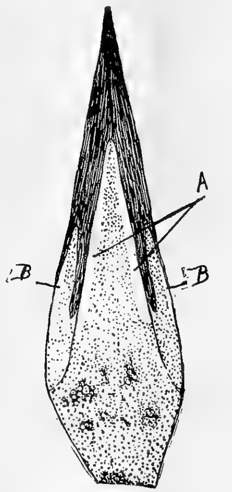

Fig. 3.—Chin and Throat. Pileated Woodpecker (Ceophloeus pileatus). To show the apteria on the lower mandible.

about equal length, and the rest decrease rapidly, the eleventh being the shortest, though it is interesting to note that it is longer than the first primary. No sexual differences were noted in the pterylosis until I examined the proportionate lengths of the primaries, when I was astonished to find a difference which seems well

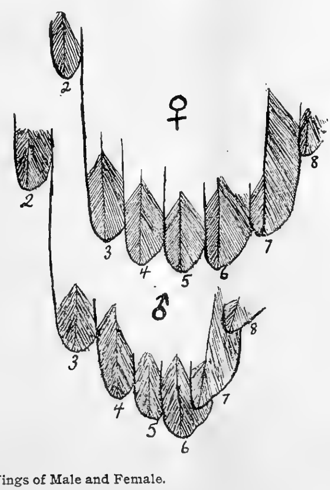

Fig. 4.—Wings of Male and Female.

worthy of note. Of course it must be remembered that I examined only one specimen of each sex, and so this difference may be only an individual variation, but it is so great as to warrant its illustration. In Fig. 4 will be seen the tips of the wings as they appeared in each sex, and the difference in shape will be at once remarked. In both the first primary is very short, only one-quarter the length of the sixth; the second is considerably longer, reaching, in the male, to within two and one-fourth inches of the tip, and in the female to within one and three-fourths inches; the third is next in both sexes, but is three-fourths of an inch shorter than the sixth in the male and less than one-fourth of an inch in the female; the fourth is almost equal to the fifth and sixth in the female, but in the male is shorter than the seventh; the latter in the female is much shorter than the third; in the male the eighth, ninth and tenth are all longer than the second, while in the female the latter is longer than the ninth and tenth. Thus we see that the wing formula in the two sexes is as follows:

Male,	-	6	5	7	4	3	8	9	10	2	1
Female,	-	5	6	4	3	7	8	2	9	10	1

It is hardly necessary to state that both wings showed these same differences, which Fig. 4 will make clear.

Aftershafts are present on all the contour feathers, and are of fairly good size though rather weak. The oil-gland is ornamented with a large tuft of white feathers in marked contrast to the surrounding black. Down-feathers seem to be wanting, though "half-down," as Nitzsch calls it, is present on most of the spaces. Filoplumes are plenty on all the tracts.

Figs. 3 and 4 are drawn three-fourths natural size, and Figs. 1 and 2 are not quite one-half.

SECRET LANGUAGE OF CHILDREN.

BY OSCAR CHRISMAN, A. M., FELLOW IN CLARK UNIVERSITY, WORCESTER, MASS.

We adults are rather apt to rate children's powers too low. This, no doubt, comes from a lack of study of these powers, and, perhaps, from a wrong comparison of the child with the adult. In the power of originating it may be that the child is the superior of the adult. This is well illustrated in the forming of languages. In this field the child seems to be perfectly at home, as may be shown to any one who will make a study of such; or if he will look back into his own childhood he will find left in memory traces of such languages, or if one will keep his ears open among children he will be very sure to find such languages here and there. Only on the other Sunday afternoon, while, with my wife and little girl, stopping at a small depot on a railroad in South Worcester to rest from a walk, a number of pretty tough-looking boys came along and stopped to play. At first, from their language, I thought they were foreigners, but I soon found out that they were using a language of their own. I did not have the opportunity at this time to make inquiries about their language, for which I am truly sorry.

The editor of "Am Ur-Quell,"* a German Folk-Lore paper, gives over 150 specimens of Secret Languages collected during the past three years. To be sure, quite a number of these are not languages of children, as some are of thieves, peasants, secret societies, etc., but who knows but that many of these may have their foundation in child-languages?[1]

*I am indebted to Dr. A. F. Chamberlain, Lecturer in Anthropology, Clark University, for having my attention called to these languages in Am Ur-Quell, and also for the privilege of using his numbers of this journal.

[1] I am indebted to Mr. L. N. Wilson, Clerk of Clark University, for his having called my attention to the following: " . . . . he went on to mention the one sole accomplishment which his sons had imported from Winchester. This was the Ziph language. . . . . Repeat the vowel or diphthong of every syllable, prefixing to the vowel so repeated the letter G. Thus, for example: Shall we go away in an hour? This in Ziph becomes: 'Shagall wege gogo agawagay igin agan hougour?' "—"The Collected Writings of Thomas de Quincey, New and Unabridged Edition," by David Mason. Edinburgh, 1889, vol. I., p. 202.

In this list I find "Gibberish," "The Black Slang," "The Rhyming Slang," "Medical Greek," "Potters' Latin," "Dog Latin," "Robber Language," "Goose Language," "Crane Language," "Zither Language," "Bob-Language," "Erbsen-Language," "Sa-la-Language," "Schu-Language," "If-Language," "B-, P-, W-, O-, M-, and F-Languages."

There are many other names besides these. These names, in some instances, seem to be simply arbitrary, but many arise from the use of the languages or from some distinguishing features. "Medical Greek" takes its name from its being used by medical students. "Robber Language" derives its name from the fact that the children use it in playing that they are robbers. The B-, P-, etc.,-Languages are so called because the letter occurs frequently in the designated language.

That these languages are quite numerous and variously named is shown from there being in "Am Ur-Quell" more than eighty different kinds named. Twelve of the letters of the alphabet are used as names of these languages, and every letter of the alphabet, except X and Y, is used either as a name or to begin a name among these alphabets.

I shall not go into details concerning these different languages, but give some few examples:

1. B-Language.
   Gubuteben morborgeben.
   (Guten morgen.)
2. P-Language.
   Gupupen mopopen.
   (Guten morgen.)
3. W-Language.
   Guwuwen momowen.
   (Guten morgen.)
4. O-Language.
   Jadakokkebob = Jacob.
5. F-Language.
   (1) Derererfer Baumaumafouun ististafist grnüünafün. (Der Baum ist grün.)
   (2) Wennfenenefes donefoch enefendlinefich frühnefülinefing wünnefürdenefe.
   (Wenns doch endling Frühling würde.)
6. Ubbala Abbala Language. (Copenhagen.)
   Nubbala ebbala jebbala abbala skribbala, übbala leibbala.
7. Rst.-Language. (Copenhagen.)
   Ereseteldgarasatamlarasata Irisitisarasataforosotold.
   (There are no translations given to these two specimens.)
8. Sa-la-Language.
   The writer of this article in "Am Ur-Quell," G. Schlegel, says he found this language among the Chinese children in Amoy in 1858.
   Goasoa kasa lisi kongsong, or, Goaloasoa kalasa lilisi konglongsong. [Goa (I) ka (to) li (you) kong (say)].
9. Robber Language.
   (Used among the children in Guben (Niederlaus).
   Ein fein le fein gu hu le fu tes hes le fes wort hort le fort fin bin le fin det het le fet ei hei le fei nen hen le fen gu hu le fu ten hen le fen ort hort le fort.
   (Ein gutes Wort findet einen guten Ort.)
10. Potters' Latin.
   Used by school-children of Danzig and Königsberg. Each consonant is placed before and after a short *O*; the vowels remain single.
   Frischbier=fof ror i schosch bob i ror.
11. Dog Latin.
   The speech of a little child just learning to talk is termed by some Dog Latin. Dog Latin was, perhaps, though first used, says the writer, as a term of reproach to designate a language, made up by the ancient merchants of Nievenhagen and Groenstraat, two villages in Southern Limburg. The root words are Limburger Low German; the connectives are Low German; but the substantives and verbs are foreign—Hebraic, Latin, French, Old German—but for the most part distorted and corrupted.
   Benk und blag = Mann, thuren = Frau, wuiles = Junge, flitsj = Mädchen, hock = Kredit, keut = Bier, plinten = Lumpen, sipken = ja, nobis = nein. The numbers all had foreign names.
12. Crane Language. (Denmark.)
   (1) Mads Peder Thomsen.
   Marbe Perbe derbe Thorbe serbe.
   (2) Mads = Adsmand or Adsmaj.
   Peder = Ederpend or Ederpej.
   Thomsen = Omsenthond or Omsenthag.
   3) Magedos Pegede degeder Thogedom) segeden.
13. Goose Language.
   Ichicherfich liebiberfieb dichicherfich ausauserfaus Herzerzerfersgrundunderfund, wieieerfie derererfer Ochsocherfochs dasaserfos Heueuerfeubundunderfund. (Ich liebe dich aus Herzensgrund, wie der Ochs das Heubund.)
14. Language of the Cat's Elbow.
   Dod is e kok a tat zog e lol a ssass tot dod a sos mom a u sos e non non i choch tot.
   (Die Katze lässt das Mausen nicht.)

In "Songs and Games of American Children," by William Wells Newell, I find the following languages:

1. Gibbberish (Hog Latin in NewEngland.)
   Wiggery youggery goggery wiggery miggery?
   (Will you go with me?)
2. Withus yoovus govus withus meevus?
   Ivus withus govus withus yoovus.
   (Will you go with me? I will go with you.)
3. Uwilla uoa ugoa uwitha umea utoa uluncha? (Will you go with me to lunch?) (From Cincinnati.)
4. Cat Language.
   This is the name of a language invented by children living near Boston, and was used mostly to talk to cats. The various positions of the cat were noticed and names given to such. This language seems to have been quite independent of the children's ordinary language.

One afternoon of last year in Texas one of the younger school-boys said to me: "I can talk so that you cannot understand me; I can talk Tut." This was recalled to me one day this winter, and I wrote to a young High School girl[1] of that town to gather for me what she could in re-

[1] Miss Edith Fly, Gonzales, Texas, to whom my thanks are due for such kindness.

gard to this language, and from her work I am able to give the following:

Tut Language.

The name is usually given as Tut Language, but it is also known as Hog Latin and Dog Latin. It consists of an alphabet, which will be given farther on in connection with some others. The way to learn the language is to get the alphabet and then replace the letters of a word with those of the Tut alphabet. Thus:

apple = a–pup–pup–lull–i.
boy = bub–o–yek.

At one time this Tut Language was used by many of the children of the town, but at present it is not used except very slightly. The children knew it so well that they could talk and write it as well as they could their regular language. They were able to carry on as extended a conversation as they desired, and any one unacquainted with Tut Language could no better understand what was being said than if it were a foreign tongue.

The following may be of some interest:

1. Declension of *I* in Tut.

	Sing.	Plu.
Nom.	I	wuv–e
Poss.	mum-yek	o–u–rur, or, o–u–rur–suss.
Obj.	mum–e	u–suss.

2. Declension of *ox*.

Nom.	o–x	o–x–e–nun
Poss.	o–x–suss	o–x–e–nun–suss
Obj.	o–x	o–x–e–nun

3. Comparison of *good*.

Positive,	gug–o–o–dud
Comparative,	bub–e–tut–tut–e–rur.
Superlative,	bub–e–suss–tut.

This young lady traced the origin of Tut Language as follows: She learned it from her mothor's servant, a negro girl, this girl learned it from a negro girl who got it at a female negro school at Austin, Texas, where it was brought by a negro girl from Galveston, Texas, who learned it from a negro girl who had come from Jamaica. Whether it originated in the Island of Jamaica or was carried there I cannot state, as inquiries were able to be made no further than the above.

Perhaps the most striking thing in this language is its close resemblance to the alphabetic languages given in "Am Ur-Quell." These are "Guitar Language," from Bonyhad, Hungary, "Bob Language," from Czernowitz, Austria, and "A–Bub–Cin–Dud Language," from Bergischen. I give here the four alphabets for comparison:

	Guitar.	Bob.	A–Bub–Cin–Dud.	Tut.
a	a	a	a	a
b	bop	bob	bub	bub
c	(z) zitt	cit	cin	cut
d	dot	dot	dud	dud
e	e	e	e	e
f	finf	fif	fimpf	fuf
g	g'wek	gwek	guch	gug
h	her	hir	hach	hush
i	i			i
j	jot	jot	j	jug
k	kwiss	kweis	kuck	kam
l	lol	lol	lol	lul
m	mom	mom	mom	mum
n	non	non	non	nun
o	o	o	o	o
p	pop	pop	pop	pup
q	(k) kwiss	(k & w) kwisu	ku	q
r	ror	ror	ror	rur
s	sis	sos	sis	sus
t	tot	tot	tut	tut
u	u	u	u	u
v	(w) vop	vov	vemp	vuv
w		wow	wuf	wuv
x	(ks) kwissis	(k & s) kwissos	iks	x
y		i,p,s,i,l,o,n	ypsilon	yec.
z		zit	zausis	zuz

The Guitar Language, so writes the relator, was used sixty years ago by the pupils of a school at Bonyhad, and this party was so expert in its use at that time as to be able to recall it and write it now. The Bob Language was used at school when the writer (in "Am Ur-Quell") was a pupil. The one who gives an account of this A–Bub–Cin–Dud Language states that he found the alphabet among some old scraps of paper at his home, but he is not able to say whether this was ever used at his home (Bergischen) or not.

As I stated at the first, if one will go back into memory he will find traces remaining of these child languages. In my own experience I recall three such as occurring in my boyhood days at my home at Gosport, Ind.:

1. Wilvus youvus go with usvus? This comes ringing in my ears as though it were only but yesterday since I used it.

2. Also we boys had a language in which we turned the words around, as: boy = yob. Thus if a boy got very much vexed and wanted to be expressive, he said "mad-dog."

3. I recall, too, that at one time some of us boys undertook to make up a language. I cannot give anything more of this, as it comes to me only as a faint recollection. I am quite sure, though, that this language was not carried very far nor ran very long.

4. I recall, also, a language used by some pupils in a school in Indiana, in which I taught some years ago. This was a number language. Each letter of the alphabet had a number to represent it, as: a = 5, c = 9, t = 10, etc. Thus: cat = 9–5–10.

This paper is not meant to be exhaustive, but only to give a peep into an unexplored field of child life. It is to be hoped that some day we will become much better acquainted with our boys and girls than we are now.

PARASITISM OF MOLOTHRUS ATER.

BY CHAS. W. HARGITT, PH. D., SYRACUSE UNIVERSITY, SYRACUSE, N. Y.

Of the few members of our avi-fauna known to be addicted to the habit of parasitism, none is perhaps more thoroughly confirmed therein than the common cow-bird (*Molothrus ater*). This habit is so well known that no particular attention need be called to it as a record of fact or as a matter important for general information. The purpose of this note is simply to record some interesting observations recently made in reference to a host which, so far as my own observations have gone, has not been generally considered as involved in its mischievous usurpations, though Wilson (Am. Ornithology, vol. I., p. 289) mentions it as of the number liable to such impositions.

Upon two occasions during the present summer I have noted the very ludicrous spectacle of the full-grown young of the cow-bird being fed by the chipping sparrow (*Spizella socialis*). One of these observations was made on one of the hottest days of July, and the diminutive little foster-mother panted with mouth wide open as she sought food to satiate the rapacious appetite of the adopted waif. The note of Hatch upon a similar observation made of a similar feat of the Maryland yellow-throat is so apposite to the case in question that I quote it entire: "One of the most comical spectacles ever falling under my observation in bird life has been the appearance of a young cow-bird, nearly large enough to take to its wings, still sitting *on* (*in* was impossible) the nest of the Maryland yellow-throat, and the female of that diminutive species in the act of feeding it. The tiny excavation could scarcely afford room for its feet, to say nothing of the body, and, with feathers fluffed so as to apparently double its size, the mouth extended to its utmost, while the midget foster-mother, at the hazard of being swallowed bodily, plunging her morsels far down the abysmal throat of the ungracious usurper, who has unavoidably destroyed the mother's own birdlings in the process of its development." (Birds of Minnesota, p. 274).

The other case observed was somewhat later in the month. In both cases there was but a single specimen of the parasite, as is usually the case, and not one of the bird's own offspring was to be found, which, I think, is also the usual thing.

In the case most critically studied the bird had left the nest and was diligently following the foster-parents, both of whom were in attendance upon it, now to the ground, now to a tree, and all the while persistently clamoring for food, which they were industriously seeking to supply. And it seemed to me there was in the eye of the usurper a look of impious maliciousness, which seemed to express a semi-consciousness of wild satisfaction in the scandalous imposition.

The observations were the more interesting to me in that from my earliest recollections of bird-habit and instinct the "chippy" was among the most wary and jealous of the slightest intrusion or interference about the nest. I have known the disturbance of even the foliage in proximity to be sufficient to result in its abandonment. A note in American Ornithology, p. 296, speaks of it in the same way, and refers to it as the most punctilious on this point, often deserting the nest even after the eggs had been deposited. I have myself known the nest to be deserted upon an apparently smaller provocation after the full complement of eggs had been laid. It has, therefore, seemed strange to me that an egg so different in size and markings should be accepted and brooded, or that after the full-grown intruder had flown it should yet be so tenderly cared for, though its vagabond nature must certainly be recognized! Is it probable that the maternal instincts are so strong as to overcome all scruples even of the tragic sort involved in the case under consideration?

If Spizella is the frequent victim of this parasitism I should be glad to know more about it. Of all the cases where I have found the eggs of the cow-bird in the nests of other birds, I have yet to find the first case of such in the nest of the "chippy." My observations may have been too limited, and I shall hereafter be on the lookout for making them more critical, and, at the same time, more extensive.

LETTERS TO THE EDITOR.

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

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

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

An Intelligent Squirrel.

The new home to which I removed this summer has about it two-thirds of an acre of ground bearing several old oaks, maples and other trees. Naturally enough, it has introduced me to a number of new acquaintances in furs and feathers. Of these the most interesting by far is a gray squirrel (*Sciurus Carolinensis*), the largest specimen I remember to have met. He made his first bow to us early in Septamber, taking his position one morning upon a red oak some twenty feet from the house, with his four feet spread widely on the main trunk, his head downward and his beautiful great brush poised above his gray back. Here he remained motionless for a time, peering into a second story window where two little children were busy at play. Directly one of the children—a five-year-old—caught sight of the curious eavesdropper, and made the usual hullabaloo over him, vigorously assisted by her younger brother. The squirrel paid little attention to their excitement, save that he changed his position a little, but continued his observations. For a while there was a mutual admiration society in session, which adjourned only on the arrival of certain older members of my family. On nearly every pleasant day for the succeeding month we caught sight of him on one tree or another in the neighborhood, sometimes bearing a nut in his mouth, but oftener darting about as if simply enjoying himself among the variegated autumn leaves.

Our respect for this fellow-tenant of our grounds was greatly increased one day, when a neighbor, hearing us speak of him, told us how it came about that we enjoyed the pleasure of the little fellow's company. In this neighbor's yard stood a large tree on whose top was a stump left by a decayed and broken limb. One day it was determined to trim up this tree with some thoroughness. The workmen brought their ladder and began. Soon there appeared upon the scene a much disturbed gray squirrel. Excitement was evident in every movement as the trimming proceeded. Finally the workmen left their work for the day. When all had become quiet, my neighbor was privileged to see a curious sight—one which I cannot remember seeing or hearing described before. It was the removal of a squirrel family to a new home. The old squirrel seized each young one by the nape of the neck, while the little one threw its tail about the parent's neck, as if to hold on. Then the old one, with its precious freight, descended the tree to a boundary fence, and, by characteristic hops and runs, arrived at a hollow tree top between my house and my barn. Two or three such journeys were observed before the whole family was domiciled in the new quarters.

Whether this burden-bearer was the male or the female, I know not. Perhaps some reader of *Science* can tell me. Indeed, I do not know whether there are a pair of the old squirrels here or not. We have never been able to observe two together. It is plain that the old squirrel came to the conclusion that its young were unsafe in the former home. Was this an inference from observation of the falling branches? The mere presence of man could not have been the ground of the conclusion, for a group of boys had played about the tree all summer, and after the removal the squirrel's freedom from fear in the neighborhood of human beings was often remarked. Its action in this instance resembles intelligence more than mere instinct.

RAY GREENE HULING.
Cambridge, Mass.

ST. LOUIS LIMESTONE IN POWESHIEK COUNTY, IOWA.

The St. Louis limestone described by Hall and White, and more recently by Keyes (Geol. Ia. First Am. Rep., 1892) was formerly known to occur only as far north as the eastern border of Mahaska County. Early in 1893 Bain traced this formation completely across the county in the beds of the Des Moines and South Skunk rivers, and in the North Skunk nearly to the northwestern corner. More recently several excellent exposures of this limestone have been discovered three miles above the southern line of Poweshiek County, thus extending its northern limit about ten miles beyond that previously reported. At one place nearly fifty feet of coal-measure strata were seen to rest upon the limestone. Generally, however, it was immediately overlaid with drift. Many fossils, in a fine state of preservation, were obtained from the marl which capped the rock.

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Iowa College, Grinnell, Ia.

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QUERY.

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

First inserted June 19, 1891. No response to date.

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SCIENCE

NEW YORK, DECEMBER 8, 1893.

SOME GEOLOGICAL FEATURES OF JACKSON PARK, CHICAGO.

BY D. E. WILLARD, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

VISITORS to the great Columbian Exposition during the past season can hardly have failed to have been impressed with the beauty and harmony of the landscape features of Jackson Park. Those who have made topography a study must have found it a place of especial interest.

Only when one compares the Jackson Park of 1893 with that of former years can he realize the greatness of the transformation, or comprehend the herculean task which confronted the gardener in his attempt to bring beauty and harmony out of this wild, and from an artistic standpoint, chaotic region, or appreciate the magnificent success with which the problem was finally solved and the wild waste transformed into a place fit to be called the "Garden of the Gods."

The Jackson Park of former years, in large part a wild and unimproved morass, a succession of sandy ridges and low stretches of marsh, the resting place of water-loving fowl during their season, and the resort of game-loving marksmen, contrasted with that of 1893, with its beautiful avenues, glittering lagoons and studded islands, a dreamland of beauty in its rare combination of nature and art, surely presented a marvellous example of what it is possible for the landscape gardener to accomplish.

To understand the matter at all well, the topography of the adjacent vicinity must be studied, which at once introduces us to a very interesting geological problem.

Along the borderland of Lake Michigan in the vicinity of Jackson Park may be observed ridges running southward and diverging from the lake shore, varying in width from a few yards to a considerable fraction of a mile, and in height from that which barely distinguishes ridge from adjacent lowland to twenty feet or more; the front edge, *i. e.,* the eastern or one toward the lake, usually being more or less abrupt, while that on the opposite side not infrequently grades down to the adjacent marsh so evenly as to make it difficult to determine where the ridge ends and the marsh begins.

If the observer traverses the lake shore southward he finds these ridges occurring at irregular intervals, and if he follow one of them along its course he will soon find himself at considerable distance from the lake, and ridges rising to view both to the eastward and westward.

Examination of their structure where exposed in cellars or excavations for sewers, or perchance where a sand-pit has been opened, reveals stratification and evidence of distribution and deposition in water, with alternating layers of coarse and fine sand and gravel.

The intervals between the ridges are marsh or lowland, and during certain seasons of the year are often covered with water.

The ridges are easily recognized from a distance by the oaks which usually—and, so far as our observations have extended, always—cover them in a state of nature, a sharp tree-line marking the transition from ridge to marsh.

If from the roof of the Manufactures Building or other elevated standpoint the region south of the park be surveyed, one observes that a broad level plain stretches southward from the boundary of the park (Sixty-seventh street), toward South Chicago, Pullman, and Lake Calumet, the eye being able to trace the landscape clearly as far as about One Hundredth street. This region is seen to be traversed in a generally north-south direction by lines of trees, which, by closer observation, are found to coincide with the sand ridges.

Abutting against the southeast corner of the park there is observed a grove of oaks of considerable extent consisting of broader or narrower tree-covered belts (ridges), separated by narrow strips of lowland (lagoons), while toward the lake other tree-belts are noticed, separated by low even tracts of marsh-land of varying width, entirely destitute of trees. And again, for some miles to the westward lines and patches of trees indicate ridges or outliers, and a nearer approach reveals some very high and extensive ones.

If the grove mentioned above be examined more closely, it will be found to consist of a somewhat complicated series of ridges and lagoons.

Near Seventieth street, the first ridge in the series which we can study satisfactorily—some having been destroyed by grading—to the east from Stony Island avenue (which forms the western boundary of Jackson Park) divides to the southward, and the intervening lagoon[1] gradually widens. The ridge is quite pronounced, especially as to its front, along east of the tracks leading to the Terminal Station, and here again the second lagoon, which forms the interval between the first and second ridges north of Seventieth street, becomes narrower and presumably disappeared a short distance further north in the park. This second ridge is quite regular in outline, and transversely symmetrical. It has to a striking degree the appearance of an old-fashioned country "turnpike" road before it has been distorted by heavy wagons. It is as evenly built as a gardener could have made it with his shovel and rake, rising gradually and evenly to a height of about four and a half feet, and then as evenly, though slightly more abruptly, descending to the lowland on the east or lakeward side. It is about eight rods in width at Sixty-ninth street, two blocks south of the park fence, and is separated from the next ridge by a lowland belt at this point, about four rods in width, which, however, gradually widens southward, and narrows northward till it disappears, and the two ridges unite just south of the park limits. The highest point of the combined ridge, just above the juncture of the two adjacent edges, is about six feet.

Eastward again of this third ridge or eastern arm of the second (which is about twenty-five rods in width) extends a broad level tract of lowland of a breadth of a hundred rods, covered with a growth of rushes and other marsh plants, and so low that it is covered with water during the wet seasons of the year and furnishes a favorable haunt for wild fowl and a tempting field to the sportsman. Still further east is a broad ridge sagging

[1] The terms lagoon, lowland, and marsh-belt are used interchangeably throughout this discussion, for the low interval which separates the ridges, whether or not it be covered all or any part of the year with water.

sharply along its dorsal line to a depth of half its total height; followed by another belt of lowland eight or ten rods in width; and lastly a peculiarly irregular, low, broad ridge, which quickly terminates southward, and is bordered on the east by the present lake beach.

It seems probable from a study of this region and comparison with the park to the north, that the Administration Building stands on a continuation of one or more of the ridges just described, while the broad, low belt mentioned above has its continuance embracing that part of the park on which were located the dairy and stock barns, the Stock Pavilion, the Agricultural Building, the Court of Honor or Grand Basin, and part of Manufactures Building, together with the area covered by the South Pond. Presumably the ridge on which stands the Administration Building is one which extends northward, forming part of the Wooded Island, and, as the native oaks give evidence, extends past the site of the Turkish, osta Rica and other foreign buildings, continuing along the east end of the north lagoon and Art Annex to the northeast corner of the park.

The presence of the large native oaks on a part of the Wooded Island shows the former existence of the dry, sandy soil of a ridge, while the absence of the trees in other parts becomes negative evidence that it is filled or artificial land, as the mud which was scooped out from the low places, forming the artistic lagoons, was piled along the margins to fill sinuses and level depressions.

The presence of a few large trees near the Government Building bespeaks a ridge, and the grading of the grounds indicates traces of the same, despite the gardener's skill. But whether here was a distinct ridge on which stands part of the Manufactures and the Government Buildings, and running over toward Victoria House, or whether it was only an outlier, or whether it was a ridge at all, is involved in uncertainty.

From the Convent La Rabida a ridge seems to take its origin, on which stands also the Krupp Gun Works, part of Shoe and Leather, thence extending southward along the east margin of South Pond and west of Anthropological Building, and continuing, as the ridge described as lying east of the wide belt of lowland south of the park. The ridge mentioned as adjacent to the present lake beach and very irregular in its outline and disappearing suddenly southward, just enters the park touching the Forestry Building.

Another distinct ridge crosses the northwest corner of the grounds, on which stands the California State Building, Washington, South Dakota, the Esquimaux Village and others. This soon disappears from the grounds to the westward, the oaks in Buffalo Bill's enclosure indicating its location upon the ridge. The lagoon or pond which extends into the Esquimaux Village is probably a natural sag or lagoon scooped out deeper, but it is impossible to determine, since the grading outside the park fence has destroyed all traces.

From these observations it is seen that the lagoons of Jackson Park—those objects of so much delight and pleasure to World's Fair visitors, those gem-stones of earth in a silver setting of water, which completed the indispensible features of the perfect landscape and gave the finishing touch of beauty to this fairy dreamland of nature and art—are the excavated marsh-belts which formed the lowlands between the oak-covered ridges above described, the deep muddy, marshy or water-covered places being made deeper and the excavated material being used to fill sinuses and depressions,—in fact, that these lagoons were a necessity in the reduction of a dismal desert waste to a perfect landscape garden ; were formed because nothing else could be done with the water ; in short, the process was but one of giving back to the sea her own, the lowland belt becoming what it originally was before being filled by the processes of time—a lagoon.

We have not space to discuss the geological history of this region, but may say in closing that Lake Michigan has, at a not early time, geologically occupied many square miles of territory now embraced in part in the city of Chicago and vicinity—that a great region about the head of the lake is entitled to the Indians' appellation of "Chica-gow" or "Skunks' Nest," and that these ridges are beach-ridges successively piled up by the waves of the receding lake, and the marsh-belts are the filled and filling lagoons which are formed in such shore processes.

NOTES AND NEWS.

Two numbers of a new university publication upon geology have lately come to notice, reminding one in their form and general aspect of the bulletins of the Geological Society of America. The new publication is the Bulletin of the Department of Geology of the University of California. It is edited by Prof. Andrew C. Lawson. In the two parts of the first volume there are seventy-two pages and five plates. The articles are "The Geology of Carmelo Bay," by A. C. Lawson and J. de la C. Posada, and "The Soda-Rhyolite north of Berkeley," by Charles Palache. The new enterprise has a wide field open to it. Comparatively speaking, very little work has been done upon the geology of California, and the problems are numerous and important. Aside from the two quarto volumes upon the Geology of California, the work of the U. S. Geological Survey and the few early government expeditions, little has been done in the State. Many of the problems are so intricate that it is not to be expected that they will be solved in the short time given to them by government expeditions. The great extent of the State, and the vast variety of soils and geological formations found in it, will form fertile themes for discussion and investigation for many years to come. It is the intention of the university to issue the parts at intervals as material accumulates, and when a volume of 350 or 400 pages has been printed the subscription price of $3.50 will be requested. Subscriptions can be sent to Prof. A. C. Lawson, University of California, Berkeley, California.

—G. P. Putnam's Sons will publish immediately the first volume of "Social England: a record of the progress of the people in religion, laws, learning, arts, science, literature, industry, commerce and manners, from the earliest times to the present date," edited by H. D. Traill, D. C. L. The work is to be completed in about six volumes, and the one about to be published presents the record from the earliest times to the accession of Edward I. They also announce Le Gallienne's "Religion of a Literary Man," "Wah-Kee-Nah, and Her People," a study of the customs, traditions and legends of the North American Indians, by James C. Strong, late Brevet Brigadier-General Reserve Corps, U. S. A.

—J. B. Lippincott Co. announce another of Robert S. Ball's popular books on astronomy, entitled "In the High Heavens," to be profusely illustrated by drawings in the text and full-page colored plates.

—The large and curious philological library of the late Prince Lucien Bonaparte is soon to come into the market. It numbers about 25,000 volumes. The Prince early determined to make a collection of works which would represent not only every written language in the world, but their connection one with another, and also their dialectal varieties ; and he was able to a large extent to carry out this idea. His collection includes a specimen of every English dialect. His usual plan was to get the Gospel of St. Matthew or the Song of Solomon translated into the different dialects by experts.

SCIENCE:

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THE ATMOSPHERES OF THE MOON, PLANETS AND SUN.

BY G. H. BRYAN, M. A., CAMBRIDGE, ENGLAND.

IT was only a week or two before reading Professor Liveing's interesting communication in *Science* that I had made some calculations which led me to adopt the same theory which he has advocated. The object of my investigations was, in fact, to show that we could not regard the atmospheres of the different members of the solar system as isolated masses of gas, from which molecules might fly off if their speeds were to become sufficiently great, but that, to account for the very existence of planetary atmospheres at all, it would be necessary to adopt the hypothesis of an atmosphere of excessive tenuity pervading both interplanetary and interstellar space.

It is unfortunate that Mr. Howard did not apply the principle of conservation of energy to the arguments contained in his letter in the issue of April 28. Had he done so he would have realized that the question as to whether a molecule will permanently leave the atmosphere of the Moon or a planet depends only on its speed, irrespective of direction, and does not in any way depend on whether the motion takes place in a vertical direction. In fact, if the kinetic energy of a molecule is greater than the work required to be done against the planet's attraction in order to remove the molecule to an infinite distance, the molecule will describe a hyperbola, and will fly off never to return again, no matter what be its direction of motion, provided that it does not come into collision with any other molecule or with the planet itself.

Again, the speed required to leave the Earth is about five times as great as that required to leave the Moon; but this is not because the earth's attraction is five times as great as the Moon's, but because the Earth's *potential* is about twenty-five times as great as the Moon's, consequently, in order to leave the Earth, a particle would require to have twenty-five times the kinetic energy, or five times the speed, which it would require to leave the Moon.

According to the well-known "error law" of distribution of speed among the molecules of a gas, which forms the basis of calculations connected with the kinetic theory, there must always be *some* molecules moving with sufficiently great speeds to overcome the attraction of any body, however powerful, and *some* whose speed is too small to enable them to escape from the attraction of any body, however feeb e. On this assumption no planet can have an absolutely permanent atmosphere, and no planet or satellite which has ever had an atmosphere could get rid of that atmosphere entirely. If, however, the proportion of molecules which escape is relatively exceedingly small, any changes which occur in the nature of the atmosphere of the planet will take place so slowly that countless ages will have to elapse before they make themselves felt. In order, therefore, to test the relative degree of permanence of the atmospheres of different celestial bodies, I have calculated what proportion of the molecules of oxygen and hydrogen at different temperatures have a sufficiently great speed to fly off from the surfaces of, and never return to, the Moon, Mars and the Earth. I have also given the corresponding results for the Sun, not, however, at its surface, but at the Earth's distance from the Sun's centre, where the critical speed is, of course, square root of two times the speed of the Earth's orbital motion.

The numbers, which are given in Table 1 below, represent in each case the average number of molecules, among which there is *one* molecule whose speed exceeds the critical amount. Thus, for oxygen at temperature 0°C, rather over one molecule in every *three billion* is moving fast enough to fly off permanently from the Moon, and only one in every $2.3x10^{329}$ is moving fast enough to escape from the Earth's atmosphere, while the Sun's attraction, even at the distance of the Earth, prevents more than one in every $2x10^{4040}$ from escaping.

When we arrive at such vast numbers as this, it might be reasonable to object that we have pushed the kinetic theory a great deal further than it will go. The assumptions made in many proofs of the "error" law of distribution certainly preclude its application to high speeds that are so rarely attained. Still there is no physical limit to the speed which any individual molecule might acquire in the course of colliding with other molecules. As Professor Liveing has pointed out, all that would be necessary would be a sufficiently long run of collisions, in each of which the line of impact happened to be nearly perpendicular to the direction in which the molecule in question was previously moving, so that each impinging molecule should transfer the greater portion of its energy to that one molecule.

And theory points to the conclusion that whenever there is any law of permanent distribution of the molecules of a gas, that law must be the "error" law. Hence the calculations may be reasonably expected to give a correct estimate of the proportion of molecules whose speed exceeds the critical speed, provided that the mass of gas under consideration is so large that the *total* number of such molecules is great, however small their relative proportion may be. Thus we are at least justified in regarding the figures as affording indications of the relative permanency or otherwise of the gaseous envelopes surrounding different bodies of the solar system.

One great difficulty presented by the theory is that oe taking account of the differences of temperature of the atmospheres of the different bodies. There seems to be good reason for believing that the Moon's temperaturf may fall below —200°C., in which case only one molecule in $7x10^{51}$ will be able to escape. And generally the larger members of the solar system are the hotter, and this would cause them to part with their atmospheres more readily in proportion than they would if all the bodies were at one common temperature. If the absolute temperatures of different bodies were proportional to their gravitation potentials, the proportion of molecules possessing the speed requisite to carry them off would be the same for all. This condition would require the Earth's atmosphere to have an absolute temperature roughly twenty-five times as high as that of the Moon's. Even supposing this were the case, it does not necessarily follow that the Moon's atmosphere would be of as permanent a nature as the Earth's, for the gain and loss of molecules would only take place near the upper limits of the atmospheres, where collisions rarely occur; hence the question of permanency would largely depend upon the extent of the atmospheres surrounding the two bodies.

The figures tend to show that the Earth would lose its atmosphere very slowly, even if plunged in vacuo, and that the Sun's atmosphere may be regarded as *practically* permanent, even independently of the hypothesis of an interstellar atmosphere. But the impossibility of assuming losses to be taking place from the atmospheres of planets without a compensating accession of molecules from the surrounding space is at once evident when we endeavor to trace the past history of the solar system.

If the Moon ever had an atmosphere which has now flown off into space, losses of a similar nature must necessarily have taken place in the atmospheres of all the planets at a time when they were much hotter than they are at present, especially in the case of so small a planet as Mars. And if we trace the history of the solar system further and further back, we find that, if the planets were hotter and hotter, they must therefore have been parting with their gaseous envelopes at a greater and greater rate,—a condition of things which would render it impossible to account for the initial existence of planetary atmospheres.

The nebular hypothesis supposes the Sun and planets to have been evolved by the gradual contraction and condensation of a nebulous mass of gas. This process would be exactly the reverse of the flying-off process suggested by a perusal of Dr. Robert Ball's paper.

It is only necessary to assume the existence of a distribution of matter of excessive tenuity pervading interplanetary space, in order to account for the permanence of the planetary atmospheres at all temperatures; and such an assumption, taken in conjunction with the kinetic theory, is *quite compatible* with the absence of any *perceptible* atmosphere surrounding the Moon.

The kinetic theory enables us to compare the densities at different points of a mass of gas in equilibrium under fixed central forces, such as the attractions of the celestial bodies. If we apply the theory to the system consisting of the Sun, Moon and Earth, we shall find the relative densities given in Table 2, the density of the corresponding gas in the atmosphere at the Earth's surface being taken as unity. If we take the density at an infinite distance from the Sun to be unity, the corresponding results will be given by Table 3.

The assumption on which these results are calculated may be called an "equilibrium theory," since it takes no account of the motions of the bodies in question, and it assumes a permanent distribution to have been attained, so that the whole of the mass is at a uniform temperature.

When every allowance is made for the artificial character of the assumptions, it is still highly unreasonable to suppose that the Moon could have an atmosphere so far in excess of that required by the equilibrium theory that its presence could be detected even by the most careful observations.

And so far from its being necessary to assume the density of the interplanetary atmosphere to be a millionth of a millionth of the density at the Earth's surface, we should, on the assumption of a uniform temperature of 0°C, have to divide the latter density by a million over and over again fifty-five times, before we had reached the degree of tenuity required by the equilibrium theory for the interplanetary atmosphere in the neighborhood of the Earth's orbit. Taking the number of molecules in one cubic centimetre of air as a million million million and employing the figures calculated for oxygen, we should have to construct a cube, each of whose sides was 10^{100} kilometres long, in order to enclose a hundred molecules of a gas of this degree of tenuity. Thus, if we multiply a million by a million and repeat the process sixteen times and then multiply by ten thousand, and take this number of kilometres as the side of a cube and place one hundred molecules of gas inside it and the Earth in the middle, that hundred molecules would be sufficient to make up for any loss that is going on at the surface of the Earth's atmosphere. It is similarly evident from the figures in Table 1 that countless ages must elapse before a single molecule leaves the Earth's atmosphere, and that no perceptible equalization is taking place between the atmospheres of different planets.

If we try to compare the atmospheres of different planets, such as the Earth and Mars, the "equilibrium theory" breaks down completely. But it would be highly unreasonable to suppose that anything like a *permanent* law of distribution existed between two bodies at such vast distances apart, separated by a medium of such extreme tenuity, and subject to solar radiation and so many other disturbing causes. The molecules of gas flying about in interplanetary space are so few and far between that collisions can only rarely take place between them, whereas any tendency of approach towards a permanent state of distribution must necessarily depend on frequency of collisions between the molecules. Hence the rate of equalization of energy among the molecules of so diffuse a medium must be infinitesimally slow, so slow indeed that practically no such equalization is taking place at all. It is different in the case of two bodies so near one another as the Earth and Moon. Among the molecules of gas which at any time might find themselves in the neighborhood of the Moon and Earth, the greater number would be drawn in by the more attractive body, and the moon would not, therefore, be likely to obtain more than her fair share of air, which, as we have seen, is very small in comparison with that allotted by the equilibrium theory to the Earth.

Table 3 affords some idea of how the density of the Earth's atmosphere would increase with the gradual cooling of the solar system. According to this theory, a similar increase has been taking place in what little atmosphere there is surrounding the Moon, and at no period of its history has it possessed an atmosphere of oxygen and nitrogen comparable in density with that of the Earth. A decrease of density in a planet's atmosphere could only take place by the condensation in liquid form of vapors present in it, not by matter leaving the planet.

The figures given in Table 3 are more than sufficient to account for the comparative rarity of hydrogen in the Earth's atmosphere, but a similar argument would also, of course, require a considerable preponderance of oxygen over nitrogen, which is contrary to experience. But here again we have pushed the equilibrium theory too far. It is highly probable that the number of molecules flying about both in interplanetary and interstellar space is far greater than that given by the accompanying tables, and the inference is that the atmospheres of the planets are increasing in density at a rate far greater than that due to cooling alone. Even so, however, the few molecules picked up by the Earth in the course of a year or even a million years may have no *appreciable* effect on the density or composition of the atmosphere. Hence, while, as Professor Liveing asserts, the same chemical elements may be expected to enter into the constitution of all the celestial bodies, there appears to be no warranty for supposing them to be in any way regularly distributed as regards their relative proportions; and on the other hand

there is every reason for believing that the existing law of distribution may differ vastly from the law of permanent distribution required by the kinetic theory of gases.

TABLE 1.

Average number of molecules of gas to every one whose speed is sufficiently great to overcome the attraction of the corresponding body:

	Hydrogen at 0°C (=273° absolute) Oxygen at 4095°C (=4368° absolute.)	Hydrogen at —205°C (=68° absolute.) Oxygen at 819°C (=1092° absolute.)	Hydrogen at —246° (=17° absolute.) Oxygen at 0°C (=273° absolute.)	Hydrogen at —269°C (=4¼° absolute.) Oxygen at —205°C (=68° absolute.)
Moon's surface	3.6	610.0	2.7×10^{12}	6.9×10^{51}
Surface of Mars	3920.	5.0×10^{15}	1.0×10^{65}	1.8×10^{263}
Earth's surface	6.0×10^{19}	3.3×10^{81}	2.3×10^{329}	4.5×10^{1322}
Earth's atmosphere at a height of 80 miles	2.3×10^{19}	7.6×10^{79}	5.7×10^{322}	1.5×10^{1296}
Sun at same distance as Earth	2.7×10^{307}	6.6×10^{1233}	2.0×10^{4940}	1.7×10^{19767}

TABLE 2.

Relative densities of oxygen and hydrogen in a permanent distribution taking their densities at the Earth's surface as unity:

	H at 0°C (273° abs) O at 4095°C (4368 abs)	H at —205°C (68° abs.) O at 819°C (1092 abs.)	H at —246°C (17° abs.) O at 0°C (273° abs.)	H at —269° C (4¼° abs.) O at —205°C (68° abs.)
Earth's surface	1	1	1	1
Earth's atmosphere at a height of 80 miles	.3859	.02268	2.414×10^{-7}	3.4×10^{-27}
Moon's surface	3.1×10^{-20}	9.4×10^{-79}	37.7×10^{-313}	3.5×10^{-1249}
At Moon's distance from Earth	4.6×10^{-21}	4.6×10^{-82}	4.5×10^{-326}	4.0×10^{-1302}
At Earth's distance from Sun	2.1×10^{-21}	1.9×10^{-83}	1.4×10^{-331}	3.6×10^{-1324}
Interstellar space	2.7×10^{-330}	4.9×10^{-1318}	5.6×10^{-5724}	9.9×10^{-21694}

TABLE 3.

Relative densities in a permanent distribution, taking the average densit of distribution of the gas in interstellar space as unity:

	H at 273° absolute O at 4368° abs.	H at 68° abs. O at 1092 abs.	H at 17° abs. O at 273 abs.	H at 4¼ abs. O at 68° abs.
At Infinity	1.0	1.0	1.0	1.0
At Earth's distance from Sun	7.9×10^{308}	3.9×10^{1235}	2.4×10^{4942}	3.6×10^{19769}
At Moon's distance from Earth	1.7×10^{309}	9.4×10^{1236}	8.0×10^{4947}	4.0×10^{19791}
At Moon's surface	1.2×10^{310}	1.9×10^{1246}	1.4×10^{4961}	4.2×10^{19844}
At Earth's surface	3.7×10^{329}	2.0×10^{1317}	1.8×10^{5273}	1.0×10^{21073}

ON THE LIFE ZONES OF THE ORGAN MOUNTAINS AND ADJACENT REGION IN SOUTHERN NEW MEXICO, WITH NOTES ON THE FAUNA OF THE RANGE.[1]

BY C. H. TYLER TOWNSEND.

THE range known as the Organ Mountains, in southern New Mexico, was determined by the U. S. Geodetic Survey, if I mistake not, to rise to a height of 8,800 feet above sea-level. This altitude has been carefully veried by observations taken by Professor C. T. Hagerty, of the Civil Engineering Department of the New Mexico Agricultural College. The western base of the range is about twelve miles to the eastward of Las Cruces, in Doña Ana County. The range runs nearly north and south for a distance of about twenty miles. It varies in width from about four to eight miles, the north extremity as well as the south one being much narrower. It is intersected a little south of the middle by a wide and detoured pass known as Soledad Cañon. The San Augustine pass divides the range near its north end. About two miles to the north of this pass begin, by common consent, the San Andres Mountains, a lower range which extends on to the northward for about fifty miles. About three miles south of San Augustine pass is a rather high and more difficult drop in the range, known as Bayler pass. The highest peaks of the Organs are north of the centre of the range, and their upper portions are mostly bare and nearly inaccessible. There is a ridge between the southernmost two peaks and those peaks to the north of them. This ridge is probably 8,000 feet or more in elevation, and its highest portion is the point to which the zones given below have been traced. It dips about 200 feet at its northern end.

[1]Read before the New Mexico Society for the Advancement of Science, at Las Cruces, April 6, 1893.

The altitude at the western base of the range is about 4,800 feet, or 1,000 feet higher than the site of Las Cruces, situated twelve to fifteen miles west on the edge of the Rio Grande Valley. Thus the above mentioned ridge is, roughly speaking, about 4,000 feet above the surrounding country, or about 3,000 feet above the base of the range.

The various points above mentioned will be better understood by consulting the accompanying diagram of the range. It is only a diagram, no attempt having been made to secure accuracy of detail.

It may be stated that, to the northeast of the range, stretch away the plains of San Augustine; while to the northwest is the vast waterless expanse known as the Jornada del Muerto, or Journey of the Dead, where seventy miles has to be covered between springs. To the eastward of the range is a vast level sandy plain which extends some eighty miles to the Sacramento Mountains, and plains stretch away likewise to the southeast, and for a less distance to the south. For some of the beauties of the Organ Mountains, I would refer the reader to a paper by Mr. Charles H. Ames, in *Appalachia* for 1892. The point reached by Mr. Ames was the lowest part of the ridge above referred to between the peaks, being the dip at its northern end.

Beginning at the east bank of the Rio Grande River, in the bottom of the valley, and going eastward until the highest portion of this ridge between the peaks is reached, the following zones, in the order given below, are encountered. The actual ascent to this ridge, during which most of the data of the higher zones were carefully noted, was made on Nov. 12, 1892. We left the house at Riley's ranch at 9.00 A. M., and reached the highest part of the ridge at about 12.15 P. M., thus making fully 3,000 feet in three and one-quarter hours. Starting back at 12.30 P. M., we reached the house again at 2.55 P. M. It should be stated that there was much snow in the dense brush through which we passed in the higher portions of the range, and that on many occasions we had to proceed in a reclining attitude over long stretches of smooth rock at an angle of about 35°. The house at Riley's ranch is 4,900 feet altitude, and the ridge, as above mentioned, about 8,000 feet.

Tornillo or Cottonwood Zone.

About 3,500 to 3,800 feet.

Characteristic plants.—Prosopis pubescens (tornillo), Populus fremontii var. wislizeni (valley cottonwood), Salix spp. including S. longifolia (willows), Aster spinosus (spring aster), Helianthus annuus (common sunflower), Helianthus ciliaris (dwarf sunflower), Xanthium sp. (cocklebur), Rhus sp. (sumach), Sphæralcea angustifolia, Solidago sp. (golden rod), Baccharis angustifolia (at its climax), mistletoe, grasses, etc.

Mesquite Zone.

About 3,800 to 4,800 feet.

Characteristic plants.—Yucca baccata (Spanish bayonet—at its climax), Yucca angustifolia (narrow-leafed yucca), Prosopis juliflora (mesquite), Larrea mexicana (creosote bush), Opuntia lepticaulis (vine cactus), Opuntia arborescens—some (tree cactus), Ephedra nevadense (clapweed), Opuntia spp. (smaller-leafed prickly pears), Opuntia engelmanni—some (prickly pear), Echinocactus wislizeni (barrel cactus), Cereus spp. (bunch cacti), Atriflex canescens (sage bush), Fallugia paradoxa—some along arroyos, Fouquiera splendens (candle wood), Krameria parvifolia, Zizyphus lycioides, Baccharis angustifolia, Parkinsonia sp. (?), Acacia sp. (cat's-claw thorn), Chilopsis saligna (along arroyos, and especially near base of mountains), Perezia nana, certain grasses on plains to north (Jornada del Muerto), etc.

Dasylirion or Scrub Oak Zone.

About 4,800 to 6,800 feet.

Characteristic plants.—Dasylirion wheeleri (sotol), Quercus undulata var. wrightii (scrub oak), Opuntia arborescens (tree cactus—at its climax), Yucca baccata (Spanish bayonet), Accacia sp. (cat's-claw thorn), Opuntia engelmanni (prickly pear or tuna—at its climax), Agave heteracantha (century plant), Agave parryi (Parry's century plant), Unguadia speciosa (Mexican buckeye), Celtis occidentalis (hackberry), Fraxinus sp. (ash), Robinia neomexicana (New Mexico locust), Fallugia paradoxa, etc.

Juniper or Cedar Zone.

About 6,800 to 7,500 feet.

Characteristic plants.—Juniperus sp. (cedar), Cercocarpus parvifolius (mountain mahogany), Garrya wrightii, etc.

Pine Zone.

About 7,500 to 8,800 feet.

Characteristic plants.—Pinus edulis probably (piñon), Pseudotsuga douglassii (Douglas spruce), Quercus undulata var. gambellii (a scrub oak on top of ridge, 8,000 feet), Pinus ponderosa (Californian pine), etc.

The above are the more important forms of vegetation met with in going up past the Modoc mine to the top of the ridge (slope with western exposure); in going up a long side cañon which opens into Soledad on the north at a point about a mile east of Mr. Isaac's place (mostly south exposure); and also as noticed in general in the whole range, on the western slopes, from Soledad to the south end. As before said, the zones were more particularly noted in the ascent to the ridge above the Modoc mine, Nov. 12, 1892, as this is about the highest accessible point in the range.

On Nov. 26, 1892, an ascent was made to the top of the ridge of the northeast portion of the range. The results of this trip are detailed separately below. Going up this slope, which has a north-northeast exposure, the following seventeen characteristic species of vegetation were noticed. The real ascent was begun at a point about four or five miles a little east of south of San Augustine. Exactly a year before this, I made an ascent nearly to the top of the higher portion of the same ridge about two miles farther to the westward, on which many of the same plants were also noted.

Plants found on going up northeast slope of Organ Mountains, Nov 26, 1892.—The vertical distance was divided into approximate fifths, which are spoken of as first to fifth belts. This vertical distance from the level at San Augustine to the top of the ridge is probably about 2,000 feet, the ridge being, apparently, about 7,000 feet elevation at its eastern end. The lower range of the hardier species, as shown below, is due to the north or northeast exposure.

DIAGRAM OF THE ORGAN MOUNTAINS IN SOUTHERN NEW MEXICO.

1. Organ peak.
2. Organ pass.
3. Bayler pass.
3. Sugar loaf.
5. Old San Augustine hotel.
6. Davies-Lecinsky ranch.
7. Stephenson-Bennett mine.
8. Riley's well.
9. Riley's ranch.
10. Modoc mine.
11. Soledad canon.
12. Isaac's ranch.
13. Highest peaks (8,800 ft.).
14. Highest part of ridge betw. peaks.
15. Dip of ridge at north end.
16. Side canon opening into Soledad.
17. Ridge of northeast part of range.
18. South and wagon pass.
19. Bishop's Cap.

1. Cat's-claw thorn (Acacia sp.).—Extending from near base of mesa-like prolongation of north end of range through first belt.
2. Mulberry (Morus parvifolia).—Upper portion of cat's-claw thorn area or first belt.
3. Mexican buckeye (Unguadia speciosa).—Second belt.
4. Wild grape (Vitis sp.).—Second belt.
5. Wild cherry (Cerasus sp.?).—Second belt.
6. Maple (Acer sp.).—Second belt.
7. Small bunch cacti (Cereus 2 spp.).—Third belt.
8. Ash (Fraxinus pistacifolia).—Third belt.
9. Hackberry (Celtis occidentalis).—Third belt.
10. Willow (Salix sp.).—Third belt.
11. Cottonwood (Populus sp. much resembling P. fremontii).—Third belt.
12. Scrub oak (Quercus undulata var. wrightii).—Third and fourth belts. Often hung with mistletoe.
13. Piñon (Pinus edulis?).—Large trees on lower ex-

tent of fourth belt. (Perhaps P. ponderosa as well).

14. Jimson weed (Stramonium sp.)—Fourth belt.

15. Mountain mahogany (Cercocarpus parvifolius).—Fourth and fifth belts.

16. Oak (Quercus undulata var. gambellii).—Fifth belt, below but near top of ridge.

17. Thornless chaparral (Fallugia paradoxa).—At top of ridge, fifth belt, forming a thick chaparral on north slope.

It should be mentioned, as a possible explanation of the higher altitude at which the scrub oak, hackberry, etc., were found on this slope than on the western slope, that in the ascent the course of a stream was followed about to the third belt.

Notes on the fauna of the Organ Mountains.—Mammalian fauna: The range contains a wide and varied extent of country, particularly between its northern widened portion and Soledad cañon. Of the larger mammals, there were formerly, as reported by hunters, elk, mountain goat, mountain sheep, and bear. These are not known to exist there at present, but Mr. G. R. Beasley, of Soledad cañon, is reported to have killed a full-grown male mountain sheep two years ago in the Organs. There are said to be some bears at the present time in the more inaccessible portions of the range, but this is not positively known.

There are known to exist at the present time: Deer (probably the black-tailed, Cariacus macrotis); mountain lion (Felis concolor); wild cats (Lynx sp.); red and silver foxes (Vulpes spp.); skunks (Mephitis sp.); squirrels (Sciurus sp.); chipmunks (Tamias gracilis and other spp.); weasels (Putorius sp.); civet cats (Bassaris sp.); and raccoons (Procyon sp.). Bats and mice also occur. Antelope, rabbits, badgers, prairie dogs, coyotes, are found at the base or in the lower portions.

Avian fauna: Californian quail, tonto quail (Ortyx spp.), eagles, hawks, buzzards, owls, jays, woodpeckers, doves, mocking birds, orioles, whippoorwills, wrens, swallows, humming birds, and others have been noted in the range. Unfortunately specimens were not collected, so that no specific determinations can be given. Wild turkey are said to occur, but I have seen none. They were common in the range formerly.

Reptilian fauna: Rattlesnakes (Crotalus sp.), several species of harmless snakes, and several species of small lizards have been observed. The rattlers are more frequent on the plains at the base of the range. Frogs are also said to occur.

Fish fauna: There are no fishes that I know of, as the mountain streams are small and swift, and often dry, for a long season. In the Sacramento and White Mountains, about sixty to eighty miles north and northeast, there is fine trout fishing in the streams.

Insect fauna: Many species of insects abound, a large number being peculiar to the range in this region, i. e., not found on the mesa and in the valley to the westward. These, in most cases, feed on such plants and trees as are likewise peculiar to the range. The following are those species which feed on some of the principal plants, so far as I have observed them, arranged under the heads of the plants:

Sotol (Dasylirion wheeleri).

1. Thrincopyge alacris—larvæ bore flower stalks.
2. Hesperobænus n. sp.—adults eat newly forming flowers.
3. Thrincopyge ambiens—larvæ bore flower stalks.
4. Acmæodera culta—larvæ bore in flower stalks.
5. Moth—larvæ bore flower stalks.
6. Lecanodiaspis yuccæ—scale on leaves. Also on Yucca baccata.
7. Small weevil—bores in flower stalks.

Scrub oak (Quercus undulata var. wrightii.)

1. Andricus sp.?—makes a woolly, reddish gall on leaves.
2. Another gall-fly—makes a fleshy leaf gall.
3. Synergus sp. and Decatoma sp.—the first makes a large apple-like and very hard woody gall on twigs, in which the second is apparently an inquiline.
4. Geometrid moth—larva feeds on foliage.
5. Several species of Lepidoptera—larvæ feed on foliage.

Hackberry (Celtis occidentalis).

1. Pachypsylla venusta—forms a leaf-stalk or petiole gall.
2. Pachypsylla celtidis-pubescens—forms a small circular gall on leaves.
3. Cecidomyiid—makes small round gall on leaf-stems.

Many carnivorous bugs and beetles abound in the range. Butterflies are more numerous than in the valley. There are bees, wasps and ants; dragon flies, many locusts, larvæ of gnats in the streams, including buffalo gnats (Simulium occidentale); and flies of many families, especially those of parasitic and creophilous or coprophagous habits. A single specimen of a peculiar large blister beetle (Megetra vittata) has been found in the mountains and nowhere else in this immediate region, but many were found higher up in western New Mexico. Tarantulas (Lycosa sp.), centipedes (Scolopendra), viñagrones or whip-scorpions (Thelyphonus), and true scorpions also occur.

Molluscan fauna: Quite a number of specimens of a snail have been found in several parts of the mountains about half way up the range. Prof. T. D. A. Cockerell, to whom I gave some of the shells for determination, writes me that they are undoubtedly a variety of Patula strigosa Gould.

In conclusion, it should be stated that the determinations of the plants mentioned in this paper were made largely by the Botanical Division of the U. S. Dept. of Agriculture, and by Mr. Walter H. Evans, now of that Department also. A few were made by Prof. E. O. Wooton, botanist of the N. Mex. Agr. College.

POTTERY ON PUGET SOUND.

BY JAMES WICKERSHAM, TACOMA, WASHINGTON.

That the reader may not be misled by the above headline, I hasten to say that there never was any aboriginal pottery made either on the Columbia River, Puget Sound or in the regions northward to Alaska. Baskets of such strength, firmness and texture were made, however, that the absence of pottery was not a hardship upon the Indians, for they carried water in baskets, and even boiled food in them by the use of hot rocks constantly dropped in the water. But what lesson, if any, can the ethnologist learn from the absence of pottery on this northwest coast?

Let us first look at the character of the civilization existing here prior to the advent of the white man and compare it with that of other localities—say San Francisco Bay, but a few hundred miles farther south on the same shore. The Indians of Oregon, Washington, British Columbia and Alaska made and constantly used the finest canoes in the world, capable of holding fifty or sixty men. They fearlessly pursued the whale on the Pacific Ocean, far out of sight of land; and fastening their harpoons to the monster by the use of inflated bladders, they caused him to float; and after his death he was towed by a line of great canoes to the shore; where, landing the huge carcass, his captors feasted in truly Indian style. But a few hundred miles away the Indians of San Francisco Bay rode on a raft or bundle of reeds! The conclusion follows irresistibly that a different aboriginal civilization existed from the Columbia River northward to Alaska than that on San Francisco Bay. From a careful examination of the archæological remains it seems quite certain that the lines connecting the middle type of civilization of the Puget Sound region with other American civilizations lay—one up the Columbia and across to the Ohio region, and the other by way of the Snake River, Great Salt Lake and the Pueblo region, and connecting with the Mexican country. But in each of these regions —in Ohio and Mexico—we find pottery in abundance, but none in the Puget Sound basin. This cannot be on account of lack of material, for the finest potters' clay exists in great beds throughout this region on the surface, and many potteries now work it. What is the conclusion, then? It is that the high civilization of the Northwest coast did not come either from the east or south!

This middle type of civilization on Puget Sound made splendidly carved war canoes; the finest basket work in America; featherwork like the Aztecs; metalics like those of Moqui; wove blankets equal to the Navajo; worshipped the sun like the Mexican, and made stone gods equal in carving to those of Central America; as carvers of wood they have no equals in America; they were artisans skilled in carving, weaving and painting; they built permanent homes of great posts and cedar boards, exactly like the Mongolian tribes of Asia—exactly like the Japanese; their beds were arranged on each side of the houses on platforms in the true Mongolian style; their language yet preserves the identical tongue spoken by the Apache and other southern Athapascan; many pure Aztec words linger north of Puget Sound—and yet they made no pottery!

No nation ever lost the art of pottery-making. The art never was known to the people of this northwest country; though they are cousins to the Algonquins and Aztecs and brothers to the Apaches, yet they had not the art possessed by these people of making vessels from clay. Not a trace of the potter's work can be found in the Columbia River or Puget Sound regions. Although these people are of kin, yet in this particular they are as distant as the poles. It follows that the Athapascans of Mexico learned the potter's trade after they left the early home of their kinsmen on Puget Sound; it also follows that the Apache and kindred tribes were migrants from the north, and it is true that the Algonquin was not a potter until after he reached the Mississippi valley.

It seems to me that one certain result follows from the known facts, viz.: That the Athapascan tribes of Mexico, and possibly the Aztecs, migrated to Mexico from the Puget Sound region—for if our Athapascans came to the north from Mexico and settled in the Puget Sound basin, why did they not bring that most characteristic manufacture, pottery, with them? I take it that the conclusion must be conceded that the migration was southward, and not by San Francisco Bay, either, but via Great Salt Lake to Mexico.

Humboldt, Prescott and other eminent authorities place Aztlan, the ancient Aztec hiving place, in the Puget Sound region, and certainly the absence of pottery here is a strong additional fact in support of their statements. If, now, it be conceded that the hiving place of the Aztecs, Apaches and other southern Athapascans was on Puget Sound, may it not also be granted that this is some further proof of the Asiatic origin of the same tribes?

DISPOSAL OF WASTE AT THE WORLD'S COLUMBIAN EXPOSITION.*

BY W. F. MORSE, NEW YORK.

When it was seen that the proposed World's Fair would occupy 600 acres of ground, have a resident population of thirty to forty thousand, and an average of one to three hundred thousand daily visitors, it was apparent that the sanitation of the grounds was a problem of some magnitude, and one that must be solved without the chance for an error, as after the opening there was no time for changes of plans.

For the drainage the Shone Hydro-Pneumatic System was chosen. This is an English apparatus, which receives, in tanks under the floors of the buildings, all the sewage from toilet rooms, and by compressed air automatically employed forces it into large tanks or reservoirs at one central station. The sewage is then precipitated by chemicals, the effluent run off into the lake, and the residuum pumped into presses which deliver it in solid cakes for disposal.

Besides this sewage sludge, the waste food products from restaurants and the refuse and litter of all sorts taken together would amount to a vast bulk of waste to be destroyed. There was no convenient place outside the grounds where this might be dumped, the lake was impracticable for the purpose; it must be burned, and this must be done on the grounds of the Exposition.

The Engle Sanitary Garbage Cremator was selected as the one which promised best results, and two large furnaces were built in the fall of '92. At the opening of the Fair the work of disposal of all garbage, sewage sludge, waste, refuse, manure and the bodies of animals was begun and has been carried on without cessation for six months. The results of this work give a better idea of the value of garbage cremation than any reports yet published.

The two furnaces used crude petroleum oil as fuel, atomized this by air, obtained the power from an electric motor, and with a pressure of twelve ounces of air and using six to seven gallons of oil per hour for each burner, obtained as high a degree of heat and did the same work which would be done by a steam burner using 120 lbs. pressure of steam and a much larger amount of fuel.

The sewage cake contained fifty-eight per cent of liquid, and of the remainder only eighteen per cent was combustible. The garbage contained water in large amounts, rising sometimes from sixty to eighty per cent. Because of the necessity of being always open for inspection, more men were employed than would usually be needed, thus adding extra expense.

There was at no time any discharge of odors, fumes or smoke from the chimney; the results of combustion (carbonic acid gas) were colorless and invisible, and being discharged fifty feet from the ground at a temperature of 1,000° were quickly dissipated.

The cost of labor and fuel was from sixty to seventy cents per ton, the sludge costing considerably more than the garbage. At other places where furnaces of this same type are employed, this cost has been brought down to eight to twelve cents per cubic yard, equivalent to twenty to thirty cents per ton.

The bodies of animals—four horses, two camels, cows, deer, elk, pigs, dogs, etc., were destroyed with ease and speed.

The Engle furnaces are constructed with two fires, the first or primary fire burning the garbage and waste by direct application of flame, the smoke, gases and fumes from this combustion being driven forward into a second

*Extract from paper read at World's Public Health Congress, Chicago, Oct. 10-14, 1893.

fire at the other end of the furnace. Combustion is assisted by hot air inlets and by combustion chambers, thus making it possible to consume the most offensive matter, to destroy or convert into gas the product of this combustion, and to do this with speed and economy at places near to houses and in the presence of large numbers of people. The garbage and sewage sludge resulting from the presence of twenty-seven and one-quarter million of persons has been destroyed in six months to the entire satisfaction of the Exposition authorities and under the observation and in the presence of thousands of persons. The furnace received the highest awards in medals.

BIRD NOTES.

BY MORRIS GIBBS, KALAMAZOO, MICH.

Rapacious birds and beasts retain their love of destroying, even after years of confinement, and it is a well-acknowledged fact that among those rapacious animals of a menagerie which are reared in confinement, we find the most ferocious and destructive examples, if they once escape and become aware of their power. As a fitting illustration of this principle of general acceptance, the following instance is offered:

A friend of mine took two half-grown young from a nest of the great horned owl, *Bubo virginianus* (Gmel.), five years ago last spring. These birds were always kept in confinement and were never in the presence of other birds or mammals which might have formed their food in the wild state.

Within a few months past the pair escaped from their pen, and instead of flying to the woods, they immediately sought out a hen-house at a neighbor's less than sixty rods distant, entered it and mangled and killed over a dozen chickens. The owner of the hennery appeared on the scene and caught the owls red-handed in the midst of the carnage.

This is certainly a much more destructive onslaught than is recorded from the visitations of wild owls in my experience.

In watching the gulls which follow the steamers on the sea or great lakes, the question has often occurred to me, Do these same birds follow the boat day after day, or do the birds of the day drop out and others take their place? I have repeatedly noticed individuals leave one steamer and follow another, oftentimes in a different course and sometimes directly opposite to the formerly selected route. Of course during the nesting season gulls or other birds cannot fly to any great distance, but in the summer, fall and winter months they certainly can and do follow ships for immense distances.

On a trip in a coasting steamer from New York to Jacksonville a few winters ago, I had a favorable opportunity to prove that a gull could follow a vessel for a great distance. Soon after passing Hatteras we noticed one of the gulls in the good-sized flock which followed the boat, to have an injured leg. The foot hung so that the passengers could readily identify the cripple.

When we reached Charleston harbor the crippled gull was still picking up scraps thrown overboard from the galley, but was soon lost to us in the fog which surrounded us for hours while we waited to cross the bar. The next morning, when the passengers went on deck, there was our gull which had met the vessel on coming from the harbor, whether by accident or design I cannot say. The cripple followed us up the St. Johns River, and was often remarked upon by the passengers who had come to know it. This bird, which was one of the larger gulls, but I cannot be positive in regard to the species, followed our steamer fully five hundred miles.

LETTERS TO THE EDITOR.

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

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

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

A Mistake in Teaching Botany.

Allowing for some measure of truth in the article under the above heading in your issue for Oct. 20, I still think that the writer is in error in several of his recommendations and in some of his criticisms.

Probably the system of teaching botany at present in vogue in many schools and colleges is far from perfect, but I very much doubt if the introduction of the changes proposed would effect any improvement. Some of them would, I am persuaded, be injurious.

The writer condemns the old plan of a spring term in botany spent on the study of the phanerogams and followed by the analysis of fifty to one hundred plants, and he suggests if no more time can be given to the study that the teacher should tell the names of the plants and save the time for more important work, adding that, as for analysis, experience shows that a large part of the work, when not done under the supervision of the teacher, is accomplished by ascertaining the common name and then going to the index. He afterwards suggests that those who have been confining the study to the phænogams should give half of the time to the cryptogams, and even adds that every one who studies botany at all should learn something about bacteria, smuts, moulds, mildews, etc., and that vegetable physiology should form an important part of the work of the first term.

I cannot infer with certainty from the article if the writer is a teacher or not, but after many years' experience in the work it appears to me that any attempt to cover the ground proposed must end in failure so far as real scientific education is concerned.

Consider for a moment the mental position of a class of beginners of any age and in any science, botany for example, utterly ignorant of scientific method and unversed in scientific work, and too often, if beyond childhood, mentally purblind from the pernicious habits of thought and work engendered by the book-instruction of which school work mainly consists. For such scholars the whole available time of a term is required to learn how to work, and the difficulty of studying even a phænogam is quite sufficient to engross their attention without entering on the intricate ground of cryptogamic botany. The organs of a plant, their parts, their names and functions, their description and the nomenclature, with other important but untechnical topics that can be incidentally introduced by the teacher, such as the elements of geographical distribution, economic botany, forestry, etc., are more than enough to fill the time while the scholar is wrestling with the elementary difficulties of the science. And the teacher of experience knows that a considerable time is necessary for the assimilation of even this minimum of knowledge, and that it is impossible to reduce this amount if any real mental discipline is desired, because the organic law of mind demands repetition, variation and attention before facts and their significance and words and their ideas can make a permanent impression on the memory and the intellect. Any other course can end only in a smattering, and in the past this method of procedure has too often brought so-called scientific teaching into disrepute.

Moreover any one accustomed to working in the higher departments knows how little can be accomplished in the hundred and twenty hours or thereabouts that form the available allowance in a single term, even after the attainment of a fair knowledge of phænogamic botany. To acquire the necessary skill in the use of the compound microscope will alone consume no small part of the time, and without this nothing of value can be done among the cryptogams.

Again, to tell a class the name of a plant instead of teaching them how to discover it for themselves is to rob the study of much of its special value in training the faculties of observation. This part of the work compels a close and repeated examination of the plant and renders the parts and their names thoroughly familiar as no other method can do it. And speaking from a long experience, I cannot believe that the art can be acquired by less practice than that afforded by the analysis of the fifty or more specimens usually required, unless, as is sometimes, and as should be always done, the description of the plants is made a part of the work. And this description should consist not merely of the filling up of the forms usually supplied, whereby the exercise is robbed of much of its value, but by requiring the whole from the scholar, thereby training him in recollecting what to look for without suggestions or leading questions. No practice in elementary botany is so useful as this.

Of course a part of every class, especially if it is large, will shirk the labor when they are out of the class-room. But shirking in the way suggested can easily be prevented by giving a plant which has no English name and in general by testing a scholar's progress by the work done in the class-room from day to day.

I need not do more than allude to the difficulty, I may say the impossibility, of supplying elementary classes with microscopes of sufficient power for the purpose advocated in the paper here referred to, without which the study must degenerate into a mere absorption of what the teacher tells. This would be little more than a waste of time and a degradation of science to the level of a mere memory study.

On yet one other point I must disagree with this author. There was, some years ago, a disposition to begin the study of a science at the bottom and work upward, and this in spite of strong remonstrances from many teachers of great ability and experience. Even a man like Huxley fell into this error, as may be seen in the early editions of his "Biology." But a few years' test showed the many disadvantages of this method, and the opposite, or older plan has been readopted. Whatever may be urged from the standpoint of theory, practice is unanimous on the other side. Steady advance from the known to the unknown is easier than a plunge into the mysteries of cryptogamic botany with its abstruse terminology and its minute, often almost invisible structure. For every one who might be attracted by the delicacy and difficulty of the subject a thousand would be disgusted and disheartened and would forsake the study forever.

The author's illustration from geology is unfortunate because in teaching this subject the best plan is to begin neither with the superficial nor the deep rocks. This savors of book geology. The proper plan is to begin with whatever rocks happen to lie within the range of the student's investigation. Here again we work from the known to the unknown.

The object of the teacher in every study should be to stimulate to farther advance, and this cannot, I think, be accomplished except by beginning with the easy and the obvious, and by assigning tasks well within the strength of the student. If a fair acquaintance with the structure of the phænogams and the methods of phænogamic botany can be attained in the first term devoted to the study, the time will have been well spent, and neither the teacher nor the average scholar can reasonably expect much more. E. W. CLAYPOLE.

Akron, Ohio.

CORAL REEF FORMATION.

IN *Science* for Oct. 20, p. 214, I observe that Professor Perkins gives a succinct account of the history of the theories of coral reef formation. Darwin and Dana have, of course, their proper place in connection with the "*subsidence theory.*" Agassiz is justly mentioned as declaring that there was no subsidence in the case of the Florida reefs. Guppy and Semper are very properly mentioned along with Murray in connection with the new views; but my name is not mentioned in that connection. Let me, then, quote from a paper of mine read before the A. A. A. S., Aug., 1856, and published in the Proceedings and also in the *Am Jour.*, Jan., 1857: "On sloping shores with mud bottom, such as we have supposed always existed at the point of Florida, a fringing reef cannot possibly be formed, for the water is rendered turbid by the chafing of waves on the mud bottom; but at some distance (in this case ten to twenty miles), where the depth of sixty to seventy feet is attained, and where the bottom is unaffected by waves, the conditions favorable for coral growth would be found. Here, therefore, would be formed a *barrier reef*, limited on one side by the muddiness and on the other by the depth of the water."

This is positively the first attempt to explain barrier reefs without resorting to subsidence. Captain Guppy worked out the same explanation independently long afterward, but on becoming acquainted with my paper promptly acknowledged the anticipation of his views. I quote from a communication by him to *Nature* (Vol. 35, p. 77, 1886): "When I arrived at the above conclusions I was not aware that substantially the same explanation had been advanced thirty years before by Prof. Joseph Le Conte in the instance of the reefs of Florida. * * * * The circumstance that barrier reefs are frequently situated at or near the border of submarine plateaus receives a ready explanation in the view *first advanced* by Professor Le Conte."

When I wrote my paper I did not dream of generalizing my conclusions or of invalidating Darwin's theory except as applied to Florida. The subsidence theory was to me then, as it is now, the most probable general theory for the Pacific reefs. I am little disposed to make reclamations. Except on the score of history, it matters little who first brings forward an idea. My paper is now thirty-seven years old. In the midst of all these discussions of new views I have been silent. My paper, therefore, has almost dropped out of the memory of the younger generation of naturalists. This is my only excuse for bringing it up now. JOSEPH LE CONTE.

Berkeley, Cal., Nov. 10

BOOK-REVIEWS.

Tables for the Determination of the Rock-forming Minerals. By F. LOEWINSON-LESSING. Translated by J. W. Gregory. New York and London, Macmillan & Co. 55p., 8vo., $1.25.

THE literature of micropetrology has of late received an interesting addition in the shape of a translation by J. W. Gregory of F. Loewinson-Lessing's tables for the determination of rock-forming minerals. Unlike the *Hülfstabellen zur Mikroskopischen Mineralbestimmung* of Rosenbusch, or the *Tableaux des Mineraux des Roches* of Michel, Levy and Lacroix, the work is something more than a bare list of the rock-forming minerals with their optical properties, but has for its avowed purpose an attempt to apply to micropetrology the system "so long applied in botany for the rapid determination of plants by using one character after another." In carrying out the scheme six tables are given, of which the first is synoptic, while the second deals with the methods of determination of minerals by the aid of polarized light; in the third the morphological character of the minerals is made the distinguishing characteristic, and in the fourth the determination of the crystalline system. In table five the minerals are classified upon crystallographic grounds, and in table six the positive or negative character furnishes the desired clue to identification. To the original work (published in Russian) the translators have added a brief chapter describing a petrographical microscope and its accessories. The work is not intended to be exhaustive, but rather as introductory to the larger works of Rosenbusch and others. To students beginning the study, and particularly to those working without instruction, the book cannot fail to be of great service.

The Mummy; Chapters on Egyptian Funereal Archæology. By E. A. WALLIS BUDGE, L.D., F. S. A. Cambridge, University Press. 404p., with 88 illustrations, 1893, $3.25.

IN his preface the author justly observes: "The preservation of the embalmed body or mummy was the chief end and aim of every Egyptian who wished for everlasting life." Hence, a large proportion of the monuments and remains of ancient Egypt are of a sepulchral character, and an intimate acquaintance with what relates to their mortuary beliefs and ceremonies well nigh exhausts Egyptian archæology.

Impressed with this fact. Dr. Budge has chosen "the mummy" as the one object of study, but this in the widest relations. He begins his volume with a brief sketch of the history of the lower Nile valley, furnishes a list of the dynasties, the cartouches of the principal kings, and a list of the nomes or provinces. Next, beginning with the Rosetta stone as a text, he describes succinctly the discovery of the methods of reading the hieroglyphic writing. This brings him to his immediate subject, the mummy, its preparation and surroundings. Short but satisfactory descriptions are given of such appurtenances as mummy cloth, Canopic jars, the Book of the Dead, *ushabti* figures, sepulchral boxes, vases, toilet articles, scarabs, amulets, figures of the gods and sacred animals, sarcophagi and tombs. Mummies of animals, reptiles, birds and fishes receive some attention, and there are instructive paragraphs on Egyptian writing and writing materials, and the Egyptian numbers and months. The book closes with lists of the more common hieroglyphic characters and determinatives. The whole is presented with great clearness, and with a full, accurate and scientific knowledge of the subject. As a practical handbook to Egyptian archæology, it has no superior, within the lines the author has laid down for himself.

The Outdoor World. By W. FURNEAUX, F. R. G. S. New York, Longmans, Green & Co. 411 p.

Our Household Insects. By EDWARD A. BUTLER, B. A., B.Sc. New York, Longmans, Green & Co. 342 p.

The Industries of Animals. By FREDERIC HOUSSA. Imported by Charles Scribner's Sons. 258 p., $1.25.

A History of Crustacea. By REV. THOMA R. R. STEBBING, M. A. New York, D. Appleton & Co. (International Scientific Series, Volume 71). 466 p., $2.00.

DURING the last few years the laboratory naturalist has very largely taken the place of the old student in natural history, and work on biological subjects in general is to-day quite largely carried on in the laboratory by means of the microscope and the dissecting knife. The reason for this can be largely traced to our modern education, which, in trying to introduce biological subjects into educational curricula, must do it in such a way that the student can carry on his work in different branches at the same time. This is hardly compatible with a very widely extended field work. As the result of this laboratory method, laboratory text books and laboratory technic have become well developed and well known, and readily meet the student's requirements. The general public, however, will always be more interested in the side of natural history that treats with animals and plants in a general way, and books to be widely instructive must contain facts never to be learned in the laboratory. Even the laboratory naturalist himself finds relief and pleasure in leaving his scalpel and microscope and turning through the pages of some well written book upon the study of nature on a broader scale. The four zoölogical books above listed represent a better class of the popular scientific books which attempt to deal with phases of nature in a wider way and in a more popular style.

The first of the four is a book designed for boys and young people in general, and has for its purpose the attracting young students to the study of nature. This book attempts to give descriptions and figures of such common animals and plants as a wide awake boy might be able to obtain by ordinary collecting methods. Methods of collection are given, simple and readily obtained forms of apparatus for collection are described, and directions are given the reader as to where and how he may most likely find certain animals and plants. In the different chapters of the book different groups of animals and plants are taken up for discussion and description. The book abounds in figures describing the organisms mentioned, as well as the apparatus used and methods of preservation. The scope of the book covers all types of animals which the boy may be supposed to find, from the smallest (not including microscopic animals) to the largest, and from coelenterates to man. It comprises the study of fresh water, land and marine animals, and is arranged in such a way as to give the boy an interest and a zest in his study of nature in whatsoever line he chooses, and withal a deal of scientific information is given. The book is, in short, just the sort of text book that a boy wants to interest him in natural history, and the figures, many of which are colored, are such as both to attract and instruct.

The second of the four is of quite a different character and is designed as an introduction to entomology. It gives an anatomical and a general account of such common insects as one may find in and around his home. The anatomical description is illustrated by figures and is more or less detailed. Bits of history of different species of insects are introduced, many accounts of interesting habits are described. As the insects are taken up one after another, the author brings up for discussion just the sort of questions which the semi-scientific reader will desire to ask and have answered. He discusses such matters as the poison of mosquitoes; the origin and habits of flies; the distribution and origin of cockroaches; methods of getting rid of many of the insect pests, etc. Quite a number of excellent figures are given illustrating the anatomy, and a few excellent photographic plates of some of the smaller insects are introduced. This book, in short, gives the sort of an account of common insects as the elementary student in entomology may desire to have.

Both of these books being English books, the species described and figured are English species. They are for this reason less valuable to an American student, but at the same time the difference in species between English and American is not so great that the books are not usable here.

The third book is even more entertaining to the general reader, treating as it does of the habits of insects and giving little or nothing in regard to the dry details of anatomy. The author attempts here particularly to describe the industrial habits of animals, more particularly those of social animals. He describes the methods of hunting and the methods of carrying of war and the general methods of defence of animals. He gives an account of the various habits possessed by animals of obtaining and storing provisions, describing the habits of gardening ants and agricultural ants, and giving an account of the slavery that exists among certain species of ants as well as their habits of "cattle keeping." He gives an account of the methods for rearing the young; of the methods of building houses and of the material and architecture of the dwellings of various animals; discusses habits of sanitation and defence against diseases. This account is extremely entertaining reading and is full of the most striking incidents. The preacher will find anecdotes for illustration; the lecturer find examples to enliven his lectures; the psychologist will find many facts to ponder over and explain, and every one will find much to interest and to wonder about, so that, on the whole, a more readable book on entomology can hardly be mentioned.

The last of the four has quite a different scope and is of a more technical scientific character. The fact that this is one of the International Scientific Series is enough to determine its high character. The author aims to give in this book a complete account of the higher crustacea (Malacostraca). He was unfortunately, however, obliged to leave out the description of the Amphipoda, since the space assigned to him would not admit of their treatment. This book begins with a careful description of the general anatomy of the crustacean groups, with an outline of their classification. This part of the book is, unfortunately, not illustrated by figures, so that it will be hardly intelligible to one not acquainted with the material beforehand. Then there follows, in separate chapters, descriptions of the various orders, tribes and families of the crustacea and a short account of all of the important genera. Numerous illustrations of more common species are given throughout the book, and the descriptions and history of the different genera will prove of especial value. This volume of the International Scientific Series is an especially valuable book for a student wanting a thorough knowledge of crustacea, for it will enable him to determine the general character and relations of any crustacea which he may find, and in many cases enable him to determine any species at hand, although it does not pretend to be a systematic account of the crustacea. Even a more valuable book will it be for a reference library book. Unlike the other three books above given, this one can hardly be regarded as a readable book, but must be looked on as a work for reference. As such a book it will find a valuable place in the libraries of all students of zoölogy.

Elementary Palaeontology for Geological Students. By Henry Woods, B. A., F. G. S. Cambridge, University Press. 222 p., $1.60.

This little book is a text-book, designed for the student to use with specimens of fossils in his hands. It gives the general characteristics of the groups of animals important to the palæontologist and a brief description of the most important genera of fossils. It gives also at the close of the discussion of each group an outline history of the group in the past. The book is of value as a guide to a student who has access to a good collection of fossils; but having almost no figures of fossils in it, it is of no use for any other purposes. It is not designed, indeed, for any other purpose, but the geological student will find it a convenient handbook to carry into a museum for reference and study.

—Messrs. Macmillan & Co., of New York, announce for January, 1894, in their "Book Reviews": "The Study of the Biology of Ferns by the Collodion Method; for Advanced and Collegiate Students." By Geo. F. Atkinson, Ph. B., Associate Professor of Cryptogamic Botany, Cornell University. Profusely illustrated. The book is designed for laboratory instruction and for reference on the development and structure of ferns. It consists of two parts—Part I. is descriptive and deals in full with the life-history of ferns; Part II. deals with methods of study. The descriptive portion of the work is arranged in seven chapters, six chapters being devoted to the Leptosporangiate homosporous Filicineæ, and one chapter to the Ophioglosseæ The chapters on the ferns trace in detail the development, morphology and anatomy of the gametophytic and sporophytic phases. The text is in no sense a compilation, but is written after a thoroughgoing and serious investigation by the author, using the Collodion Method as a means of bringing the material under contribution, so that in a very large measure it is written from nature revealed by original preparations. One unique feature of the work is the result of a critical examination by the author of the structure of the sporangium in the different orders of ferns and the dispersion of the spores. In the light of this study it is clearly shown that the customary statements regarding the extent of the annulus must be modified. The 163 illustrations are all original from camera lucida sketches, accompanied by a magnified micrometer scale, so that the reader can at once compute the magnification. All of the illustrations of sections are from objects prepared by the Collodion Method, and several of them from preparations made by students of the author during their ordinary laboratory work. The old method of free-hand sectioning rendered it an extremely difficult task even for an expert to make satisfactory sections of the delicate prothalline tissue. The profuse illustrations in this book, representing, as they do, the entire range of development, the chief features of anatomy and a comprehensive treatment of the structure of the sporangia of the different orders, are evidence of the comparative ease with which students may now, by this method, overcome obstacles which heretofore have stood in the way. From the intermediate position which ferns occupy in the plant kingdom their life-history presents a generalized view of the chief phenomena of plant life, and they are therefore admirably suited for studies of the biological aspect of botany, and form a suitable introduction to this phase of botanical instruction. The book is suited to assist students in laboratory classes in successfully tracing out the more difficult phases in the development of fern organs. The descriptive part affords a convenient means of reference at any step of the work, while the practical part deals with methods, preparation of material and instructions for prosecuting the various phases of the investigation, and is to be used as a laboratory guide. By its use, as first tested by the author in his own classes, the students are enabled to make with precision and accuracy permanent microscopic preparations of all the stages of development. Especial success has been had in adapting the collodion method to the handling of the delicate prothalline tissue, sexual organs and embryo, it being better suited to such delicate tissue than the paraffin method, and the preparation of material can be carried through in less time and with far less trouble. Permanent microscopic sections thus made serve the purpose of study, for future reference, and, if desired, for class illustration. The descriptive part occupies such a prominent part of the book that it will commend itself also to those who do not contemplate the practical study, but desire, in compact form, a much fuller account of fern history than can be obtained in ordinary text-books.

—Charles Scribner's Sons will publish a sumptuous art-work, entitled "Rembrandt: his life, his work and his time," by Emile Michel. Among their other books, nearly ready, are a new book by Dr. Henry M. Field, entitled "The Barbary Coast," a description of a leisurely journey to many interesting points in Algiers, Tunis and Tripoli.

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W. O. STODDARD, who has just written a book published by the Scribners, on "Men of Business," tells how the late Senator Stanford chopped his way to the law. "He had grown tall and strong," says Mr. Stoddard, "and was a capital hand in a hay-field, behind a plough, or with an axe in the timber; but how could this help him into his chosen profession? Nevertheless it was a feat of wood-chopping which raised him to the bar. When he was eighteen years of age his father purchased a tract of woodland; wished to clear it, but had not the means to do so. At the same time he was anxious to give his son a lift. He told Leand, therefore, that he could have all he could make from the timber, if he would leave the land clelar of trees. Leland took the offer, for a new market had latterly been created for cord-wood. He had saved money enough to hire other choppers to help him, and he chopped for the law and his future career. Over 2,000 cords of wood were cut and sold to the Mohawk and Hudson River Railroad, and the net profit to the young contractor was $2,600. It had been earned by severe toil, in cold and heat, and it stood for something more than dollars.—*Brooklyn Times.*

ORTHOMETRY.—$2.00.

IN "Orthometry" Mr. R. F. Brewer has attempted a fuller treatment of the art of versification than is to be found in the popular treatises on that subject. While the preface shows a tendency to encourage verse-making, as unnecessary as it is undesirable, the work may be regarded as useful so far as it tends to cultivate an intelligent taste for good poetry. The rhyming dictionary at the end is a new feature, which will undoubtedly commend itself to those having a use for such aids. A specially interesting chapter is that on "Poetic Trifles," in which are included the various imitations of foreign verse in English. The discussion of the sonnet, too, though failing to bring out fully the spiritual nature of this difficult verse form, is more accurate than might be expected from the following sentence: "The form of the sonnet is of Italian origin, and came into use in the fifteenth [*sic*] century, towards the end of which its construction was perfected, and its utmost melodious sweetness attained in the verse of Petrarch and Dante." In the chapter on Alliteration there are several misleading statements, such as calling "Piers the Plowman" an "Old English" poem. In the bibliography one is surprised not to find Mr. F. B. Gummere's admirable "Handbook of Poetics," now in its third edition. In spite of these and other shortcomings, which can be readily corrected in a later issue, this work may be recommended as a satisfactory treatment of the mechanics of verse. A careful reading will improve the critical faculties.—*The Dial.*

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SCIENCE

NEW YORK, DECEMBER 15, 1893.

DROPSICAL DISEASES OF PLANTS.

BY GEO. F. ATKINSON, BOTANICAL DEPARTMENT, CORNELL UNIVERSITY.

RECENT progress in the study of fungi and bacteria has revealed many standing in casual relation to several plant diseases which were of a hitherto mysterious nature and which were supposed to have been due to atmospheric or solar influences. The effect has been to create a firm belief in the germ theory of plant diseases, and there is consequently a strong tendency in certain quarters to apply the germ theory to all cases of phytopathology. The first fruits of investigations leading to the determination of bacteria and fungi as the cause of certain obscure blights of plants were either rejected *in toto*, or received *cum grano salis*. Now it is the fad to attribute all phases of disturbance, short of artificial injuries or those violent injuries produced by the elements, to the agencies of micro-organisms.

It must be urged, however, that there are some purely physiological diseases of plants. But so strong just now is the leaning to the germ theory that any departure from this path must be fortified by very careful experiments and inoculations with the germs associated with the trouble in order to carry conviction not only to one's self but to others.

The writer had occasion last winter to investigate a very mysterious disease of tomatoes[1] grown in the forcing houses of Cornell University. Typical cases of the disease presented the appearance so characteristic of certain mildews. The leaves were strongly curled and the veins on the under side were swollen and whitened. Large patches of the same kind were also found to exist on the stems. Contrary to expectation, a microscopic examination did not show the presence of any fungus of ordinary dimensions in the early stages of the trouble. The young and succulent tissues of the plant were strongly turgescent and the cells in the affected areas were stretched radially to an enormous extent. These tissues ultimately collapsed and in many instances the loss of water content from these places was so great that the affected parts of the plants died. In other cases the loss of water was more gradual where the turgescence and rupture of the cells were not so profound. Then the cushions of collapsed tissue were dry, and presented a tomentose appearance, and the effect upon the adjacent tissues was to interfere with the assimilatory processes, causing the upper parts of the leaves at these spots to become yellowish in color. On the stems there resulted from the collapse of the tissues elongated, depressed and blackened areas in various stages of decomposition. These sometimes extended far beyond the first appearance of the cushions of elongated cells, showing that the trouble once started would extend to other parts of the plant.

The question now to be considered was, Are these abnormal extensions of tissue caused by the influence of some microsymbion within the plant? Healthy plants were inoculated with the material taken directly from affected tissues. No result.

Dilution cultures were then made from several different affected places and fifteen different species of bacteria were obtained, three of *Bacillus*, three of *Micrococcus*, and nine of *Bacterium*. Cultures of these were made in liquid media and healthy plants were inoculated, but there was no result.

These negative results from inoculation and also the fact that when using the necessary precautions to prevent the entrance of gems from the outside, no growth occurred when culture media were inoculated with material from the interior of freshly affected areas of the plant, led to the conclusion that the trouble was due to some physiological disturbance of the plant, probably that root pressure, as it is termed, was greater than transpiration.

The conditions of the green house were such as to produce active and almost constant root absorption, while they were very unfavorable for transpiration, since there was very little disturbance of the air, the part of the house where the tomatoes were grown was poorly lighted, and the winter days were very short as compared with the nights. In the open during the summer currents of air remove quickly the water vapor given off during transpiration. This, with the longer days, favors rapid transpiration. The heating of the forcing house is also such as to make but little difference between the temperature of the soil and that of the air, and also the temperature of the soil is such as to make the roots active almost continually, while in the open there is a much greater difference between the temperature of the soil and air, in such ratio in the summer that root pressure and transpiration are more evenly balanced.

Cuttings of healthy plants were then connected with the hydrant by means of rubber tubing, the pressure of water turned on being twenty to thirty pounds. The pressure of water was so great that in a very few minutes drops of water stood out at the ends of the veins on the margins of the leaves. In a few days, since this abnormal pressure was in excess of transpiration, cushions of turgescent tissue exactly like those developed under the conditions of the forcing huse, were produced.

Another proof that the cause of the trouble was excessive turgescence is furnished by the relation of growth to the trouble. Where active growth was taking place in the cells the radial elongation did not take place. The increase in number of cells and the natural increase of the size of the cells were sufficient to accommodate the amount of water distributed to those parts of the plant. So that when there was no immediate interference with the growth of the terminal portions of the plants there were no cushions developed on the ends of the stem or branches for a distance of four to six inches. But just so soon as the growth by increase of cells ceased the cushions of turgescent tissue appeared. Also in the case of some plants on one bench, when the tops reached the glass roofing and the confined condition interfered with growth, the trouble appeared even to the extreme tips of the stem and branches. It is also to be noted that the short days and poor lighting of the house gave little opportunity for the metabolic processes in the manufacture of building material for the formation of strong cell walls.

Recently a similar trouble has fallen to my lot to investigate, which occurred on apple trees. Numerous blisters appeared on the trunk and branches of young and vigorous orchard trees. These blisters were caused by the radial elongatian of the phellogen layer of cells just beneath the periderm. The tissues ultimately collapsed, and were then subjected to the attacks of putrefactive bacteria and fungi. Inquiry of the owner developed a fact which was already inferred, that the plants were under such conditions that growth was very rapid, and then during the winter and spring were subjected to

[1] Oedema of the tomato, Bull. 53, C. U. Exp. Sta., May, 1893.

a very severe pruning. When growth began in the spring there were no leaves to produce active transpiration, and but few growing points to accommodate the excess of water which the large root system was continually pumping up. The excess of water in the phellogen layer was drawn into the interior of the cell protoplasm by the vegetable acids, and since it could not filter out readily, nor be removed sufficiently fast by transpiration, the cells were abnormally stretched and at last collapsed.

Similar troubles have been recorded as appearing on other plants, as potatoes,[2] grapes,[3] rose and plum seedlings, gooseberries, beans[4] and pears[5]; and recently Halsted has recorded it on pelargoniums.[6]

THE SPEECH OF ANIMALS.

BY HOWARD N. LYON, M. D., CHICAGO.

THAT animals have a means of communication among themselves through certain vocal sounds is a well established fact; that these vocal sounds are of sufficient range to express other than mere physical ideas, and thus to assume the importance of a language, is probable, although as yet unproven. It is towards the final settlement of this question that I wish to add my mite, and, while there is much that might be said, in the present instance I will confine my observations to a field but little explored—the attempts of animals to communicate with man.

For the last three years I have had a tame fox squirrel of which I have made a great pet. Polly has occupied a cage in the laboratory where she has been, for the most part, shut off from the sights and sounds of the outside world. Although at times the laboratory has had other tenants in the shape of squirrels, rabbits and guinea-pigs, she has formed no particular attachment for any of them, but when I am about she is usually close to me, either on my shoulder or following me about like a dog.

Unconsciously at first and later with a definite purpose I have talked to her much as one would talk to a young child. About a year ago she began to reply to my conversation. At first it was only in response to my questions as to food, etc., but later her *"talk"* has assumed larger proportions until now she will, of her own accord, assume the initiative.

Her vocabulary appears to be quite extensive, and while, for the most part, it pertains to matters of food and personal comfort, there are times when it seems as though she were trying to tell me of other things.

When I first go out where she is in the morning she immediately asks for food, and until that want is supplied she keeps up a constant muttering. Later when her hunger is appeased she will ask to be let out of the cage. Often when playing about the room she will climb onto my shoulder and *"talk"* to me for awhile in a low tone and then scamper off. Unless she is sleepy she will always reply to any remark made to her.

Her speech is not the chattering ordinarily observed in squirrels, but a low gutteral tone that reminds one both of the low notes of a frog and the cluck of a chicken. Some of the notes I have been able to repeat, and invariably she becomes alert and replies to them. Unfortunately, the effort to reproduce her tones produces an uncomfortable effect on my throat, and I have been obliged to desist from further experiments in that direction. The sounds that she makes are quick and in low tone, so the attempt to isolate words is very difficult, yet there is as much range of inflection as in German.

Another reason why I believe she is endeavoring to communicate with me is that she has used the same sounds towards other squirrels confined in the same cage, and that, while she will answer any one who addresses her, she voluntarily will only talk at length to me. That she understands what is said to her is beyond question, and, furthermore, she will distinguish between a remark made to her and one made to some one else.

I have had many pets that would answer in monosyllables to a question asked them or indicate by actions their desires, but this is the first instance that has come under my observation in which an animal has attempted more that that.

When Polly first commenced *"talking,"* I regarded it merely as idle chattering, but further observation shows that it is not such, and that the sounds she makes have a definite meaning. Moreover, the sounds she makes in *"talking"* are not the shrill notes of anger or alarm, but low, clear sounds that are unmistakably articulate.

In my fondness for my pet, have I overestimated the value of the sounds she makes, or am I right in assigning to them the characters of speech? Why should an animal not attempt to communicate with man? The higher animals are possessed of a well-formed larynx and vocal chords. Why, then, should we deny or ever question the possibility of articulate speech? And, if they can converse among themselves, why may they not attempt to communicate with man?

Anyone who has owned a well-bred dog can relate numerous instances in which his dog has clearly understood what was said to it, and the readiness with which a dog learns a new command shows an intelligence of a high order. Although a dog's vocabulary is of limited range, it has certain definite sounds that possess an unmistakable meaning. There is the short, sharp bark that expresses a want, the low, nervous bark that means discomfort, the sharp, quick bark of joy, the low whine of distress, the growl of distrust, the deep growl of anger, the loud bark of warning and the whimper of fright. When to these is added the various movements of the body, cowering in fear, crouching in anger, the stiff bracing of the body in defence, leaping in joy, and many special actions, as licking the hand of the master or pulling at his clothes, we find that a dog can express his likes and dislikes, his wants and his feeling as clearly as though he were human. Anyone who, in a time of sorrow or depression, has had his dog come to him and lay its head in his lap and has looked down into those great brown eyes so full of sympathy and love, can never doubt that the dog understood all, and in its own way was trying to comfort.

A friend's cat has an unmistakable sound for yes and no. The former is a low meyouw, while the latter is a short, sharp m'yoww. If Tom wants to go out that fact is made manifest by a quick meyouw'. If, perchance, anyone should be in the chair which Tom regards as his especial property, no regard for propriety restrains him from indicating that fact and unceremoniously ordering the instructor out. His me'youw' on such an occasion can not be mistaken. Instances of this sort are not uncommon and ordinarily fail to attract attention, but is there not here a field that will well repay a careful investigation?

Until my pet squirrel commenced her performances I regarded these things as a matter of course, but her chattering has raised with me the question, Is it not possible that our animal friends are endeavoring in their own way to talk to us as we talk to them?

[2] Ward, on some relations between host and parasite. Proceedings Royal Society, XLVII, 1890, p. 393-443.
[3] Gardener's Chronicle, 1878, I. 802, and 1889, I. 503.
[4] Sorauer, Wassersucht bei Ribes aureum, Freihoff's Deutsche Gartnerzeitung, Aug. 1880.
Pflanzenkrankheiten, Zweite Auflage, I. 235-238. Goeschke, Die Wassersucht der Ribes, Monatsschrift d. Verein z. Beford. d. Gartenbaues in den kgl. Staaten, October heft, 1880, 451.
[5] Quabrus, Wassersucht bei Birnen, Jahresb. d. Schles. Centralverein's fur Gartner und Gartenfreunde zu Breslau, 1881.
[6] Bulletin Torrey Bot. Club, XX., 1893, 391.

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INTERPRETATION OF MAYA HIEROGLYPHS BY THEIR PHONETIC ELEMENTS.—I.

BY HILBORNE T. CRESSON, A. M., M. D.

THE intent of this article is to demonstrate, as briefly as possible, the method pursued in my endeavor to analyze the Maya hieratic and demotic script by the phonetic elements of which it is composed. So far as the work has progressed the indications are that the Maya graphic system, like that of other early peoples, is based upon a primitive ideographism, most of its elements being derived from motives suggested by organic or inorganic nature and objects invented by man for his necessities. The symbols were gradually given phonetic significance, and had advanced to that stage which Dr. D. G. Brinton has designated the *ikonomatic.* The Maya script, like the ancient Mexican, is largely of this character. There are indications that the Maya script had begun to enter a stage even more advanced than that of the ikonomatic. At times sounds even so meaningless as that of a single letter are to be remarked; this is very rare. It is not my intent to advocate that they had arrived at a stage where each sound was indicated by a certain element or sign. They had, however, reached a point in their progression toward an alphabetic method where we find ideographic suggestions, phonetic characters and phonetic additions, intermingled. Particular attention is called to the assertion "begun to enter a more advanced stage" for the ikonomatic method prevailing, in the majority of cases, it is evident that the advance into another stage was but in process of transition.

The consonant sounds are indicated by the characters, yet syllabic characters frequently appear. Vowel fluctuation is one of the most important factors in Maya script, and the various combinations produced by the Maya scribes require careful and especial study. The sign v-s is proposed for this peculiarity where it occurs. For instance, Fig. 122 is a genuine syllabic character, the guttural consonant k, whose variants play an important part in Maya script. Its phonetic values seem to be kan, ka v-s, an v-s, k. Where ka v-s is indicated it is meant that this element and its variants may have any of the phonetic values, ka, ke, ki, ko; ak, ek, ik, ok, and that an v-s may = an, en, in, on; na, ne, ni, no. It is to be remarked that this method of using a syllable and portions of a syllable is quite common in Maya script. The element ban, Fig. 135, has the phonetic value of ban, ba v-s, an v-s. The syllable cab is represented by Fig. 125; it has the phonetic value of cab, ca v-s, ba v-s, and also the additional phonetic value of Ma v-s. The character of the Maya language explains these peculiarities, most of its roots being monosyllables or dissyllables, and, as in all languages, largely monosyllabic, there are many significations attached to a single word. Cab, for instance, has twelve or more different meanings. The face glyphs and drawings that accompany demotic script, and the sculptured representations that appear with hieratic script, it is my opinion, are composites of phonetic elements and ideographic suggestion, and it is an important question whether the peculiar ornamentations or decorations of the ancient Mayan structures of southern Mexico are not closely allied to these composites. This has already been suggested by me in other publications.

The plates accompanying this article, from Fig. 1 to Fig. 192, give a series of elements to which certain phonetic values have been assigned, these having been frequently repeated in new combinations with probable results, corresponding in some cases with the interpretations of De Rosny, De Charency and Thomas. They are now offered for consideration to Maya students, and as a basis for future progress in the work, subject to further alteration and change. An interesting fact is their resemblance to many of the phonetic elements of the day signs of the Chilan Balam of Kaua, which is a demotic form of the script that can readily be traced to that of the older codices. Most of the phonetic elements obtained by me and given in this article are derived from analyses of the day signs of Landa and a few of the month signs; from analyses of the hieratic script of Palenque, the Yucatec stone of the Leyden Museum and a vase in the Peabody Museum, Harvard University, found at Kabahr by Mr. Edward Thompson, United States Consul to Merida, Yucatan. The inscription on this vase is, in the opinion of Dr. D. G. Brinton and myself, a beautiful example of the demotic form of hieratic script. Variants of some of the phonetic elements on this vase may be seen in Figs. 1, 3, 4, 8, 10, 19, 22, 27, 43, 84, 85, 92, 122. Especial attention is called to the fact that many variants exist of the phonetic elements given in my list, and to use them one must habituate himself to these variations. Vowel fluctuation is the only method, in my opinion, that can explain some of the combinations used by the scribes in forming their glyphs. Especially is this puzzling in more demotic forms of script, yet I venture to say that there are but few of the day signs of the Chilan Balam of Kaua that cannot be analyzed by my method, and their evolution from those of Landa demonstrated. Space will not permit further discussion of this interesting subject.

It is to be remarked before beginning our list of values assigned phonetic elements that the consonant x or sh is interchangeable with that of ch.

Figs. 1, 2, 3, 4 = Ha v-s, a, kan v-s, ka v-s, an v-s.
Figs. 7, 8, 9, 10 = Cab, ca v-s, ba v-s, ma v-s, m.
Figs. 11, 154, a, b = Ka v-s, za v-s, composed of Fig. 6 and Fig. 1; see Fig. 154, a, b.
Figs. 12 to 22 = Man, ma v-s, an v-s.
Fig. 23 to 26 = Na v-s. Fig. 26, variant of element in day signs, Chuen and Akbal. The day sign Akbal is probably akanbal = bal, "object" or "thing," acaan = "set up"; is allied to Fig. 162, the chak glyph, composed of ideo-phonetic elements suggesting akaan-tun or "stones set up," symbols of

the chaks or bacabs and of Haa = water descending to fertilize the earth. To these perpendicular symbols we have assigned the phonetic values Ha v-s, a, kan, an v-s derived from Haa = water and akaan = "set up." They are among the most primitive elements in the Maya graphic system, and their values have been repeated so often in new combinations that there is little doubt in my mind of their truth. Combining Figs. 1, 79, 9 and 6, an ideograph of sky, water and earth is obtained, Fig. 193. Take Figs. 2 and 4 (adding black color = ik or eek) and the symbol of the four bacabs or chaks supporting the

Fig. 36 = hun, un.
Figs. 37, 38, 39, 40 = ki v-s (often used as a phonetic addition).
Fig. 41 = Xi v-s.
Fig. 42 = X.
Figs. 43, 45 = i, o, u (vowel?)
Fig. 44 = ich, ik v-s, i.
Fig. 46 = hun, un, ho v-s
Figs. 47, 48 = Ca v-s, ich, ik.
Fig. 49 = Xo v-s, sho, cho v-s.
Fig. 53 = hun, un, i.
Fig. 54 = Ca v-s, ich, ik.
Figs. 55 to 59 = Xo v-s, sho v-s, cho v-s.
Figs. 60, 61, 62 = Xo v-s, sho v-s, cho v-s, Ho v-s (dotted aspirate circle).

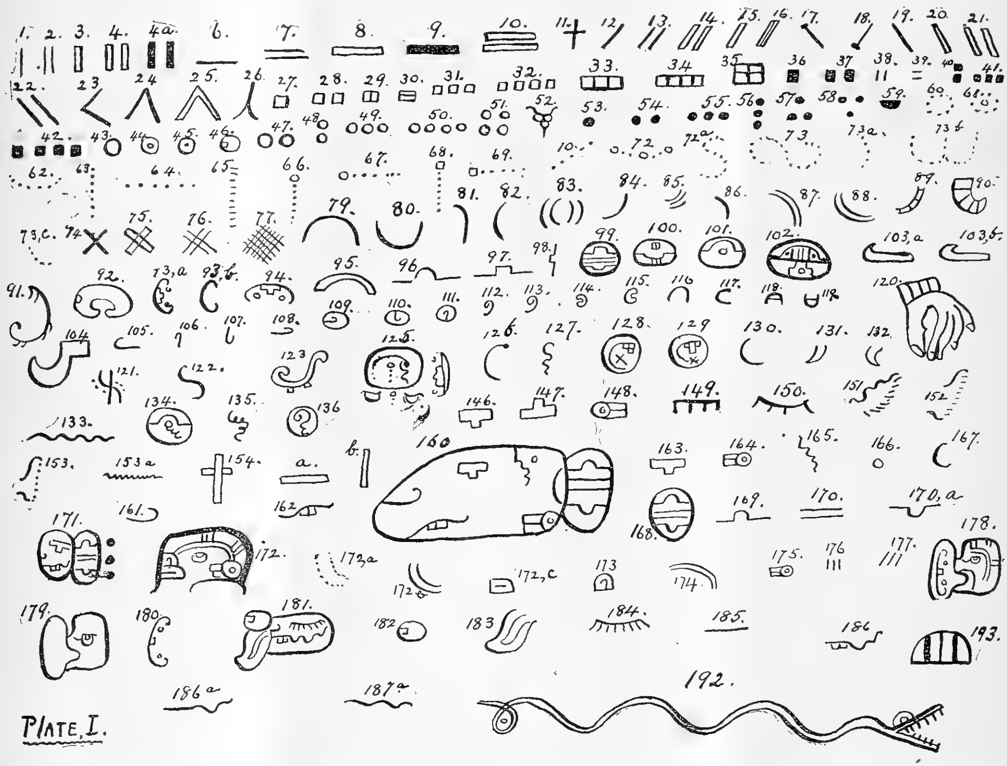

Plate I.

sky is apparent. Combine Figs. 1 and 6 and the chak, bacab, or "wind symbol," Fig. 154 is obtained—the so-called "cross." There is more method than accident in these combinations, a strong proof that the elements composing the glyphs are phonetic, as they stand for the sound of the name of the thing represented = ikonomatic.

Figs. 27, 28, 29, 30 = Ka v-s, a. Especially allied to á sounds; probably a vowel element. Is used as a phonetic addition in certain glyphs, e. g., Fig. 100, day sign kan.
Figs. 31, 33 = Xo v-s or sho v-s, cho v-s.
Figs. 32, 34, 35, 35^a kan v-s, ka v-s, an v-s.

Figs. 63 to 69 = Xa v-s, sha v-s, cha v-s, Ha v-s (aspirate line with phonetic addition). Figs. 27 and 43.
Fig. 70 = Xan, Xa v-s, shan, chan, cha v-s, Ha v-s.
Fig. 72 = Xo v-s, sho v-s, zo v-s, cho v-s, Ho v-s.
Figs. 72^a, 73 = Xan, Xa v-s, an v-s, chan v-s, Ha v-s, cha v-s, Ha v-s.
Figs. 73^a, 73^c = Xan, Xa v-s, an, cha v-s, Ha v-s.
Fig. 73^b = Xo v-s, cho v-s, Ho v-s.
Figs. 74 to 78 = Xan, shan, chan, zhan, Xa v-s, cha v-s, an v-s, Ha v-s.
Figs. 79 to 80 = Kan, chan, ka v-s, cha v-s, an v-s. (Motive derived from the life line of the serpent kan; see Fig. 192).
Figs. 81 to 86 = Man, Ma v-s, an v-s.

Figs. 87 to 88 = Cha v-s, Xa v-s, sha v-s.

Figs. 89 to 91 = Cha v-s, Xa v-s, sha v-s. (From Chilan Balam of Kaua).

Fig. 92 = Cha v-s (ch'i glyph from ch'i to bite, pinch, cling to; phonetic addition in this case indicates its value to = i; see Fig. 43).

Fig. 93 = Cha v-s.

Figs. 93ª, 94 = Ah, u (Generally used as a prefix; its phonetic elements are a variant of Figs. 92 and 93ª, Fig. 48 and Fig 163, expressing cha v-s, Ha v-s, from which ah is obtained. Its u value is suggested by chu from cha v-s).

Figs. 95 to 98 = Cha v-s, chan, an v-s, Ha v-s. Fig. 99 shows this element combined in a circle, see Fig. 171, glyph of kukulkan; see also day signs Muluc, kan, cib, akbal and their variants. See Figs. 100, 101. In Fig. 102 it appears in the well-known chak glyph of the Peresianus, whose phonetic elements express the words chak-ik = "God of Wind." See also this element as it appears in Troano 22*, an upper row of glyphs.

Figs. 103ª, 103ᵇ = Cha v-s, chan. Variant of Figs. 92, 105, 108; frequently appears with face glyph of the so-called "Long-Nosed God," or kukulkan.

Fig. 104 = Cha v-s, chan, an v-s; derived from Figs. 92 and 8; see sculptured representation of the "Long-Nosed God," left wing of Palace at Chi-chen-itza; see also sculptures of Labna and Kabah, etc.

Figs. 105 to 111 = Chan, cha v-s, an v-s, Ha v-s; variants of 92, 93, 103.

Figs. 112, 113 = Ca v-s, combined with the twisted line, as in the day sign cib. See Figs. 134, 135, 136, 137; it expresses ciban from which cib is derived. See also day signs caban and the cabil or honey glyph, Fig. 125; see also variants of this glyph in Codices.

Figs. 114 to 119 = Cha v-s, Ha v-s.

Fig. 120 = Cha v-s. The "pinching hand," with crustacean-like thumb, suggesting by its action ch'i = "to bite, pinch"; see Plate 24, Troano.

Fig. 121 = Xan, chan, shan, cha v-s (variants derived from the serpent motive, Fig. 192).

Fig. 122 = Kan, chan, ka v-s, an v-s, n (variant of Fig. 192; see Landa's n, representing the final letter of the word kan. The letters of Landa's alphabet, viz: a, b, c, e, k, n, ka, ku, x, are all derived from kan elements, and are attempts of a Maya scribe, or Landa himself (?), to approximate to the sounds of the Castilian alphabet such as ah, bay, thay, é or a, ain-nay, aikeys; k does not exist in the Spanish alphabet, but is represented in Maya script, not only by variants of the serpent line, Fig. 192, but also by a face glyph, which is a composite of phonetic elements having the values of kan, ka v-s, cha v-s; see Figs. 172 to 177. It is not only ikonomatic recalling ku = "a god," but is used with the phonetic value of kan, ka v-s. The addition of the hissing aspirate, half circle, Fig. 172ª, gives it the phonetic value of x or sh, also of ch.

Fig. 123 = Ca v-s, cha v-s; is a variant of Figs. 192 and 122. See face glyph of kukulkan (so-called Long-Nosed God) in Codices and hieratic script.

Figs. 125 to 127 = Glyph expressing cabil = "honey."

Fig. 126 = "L curve."

Fig. 123 = Kab or cab, honey glyph (see Peresianus, Plate 23) composite of Fig. 127 = ca and the twisted line ban, Fig. 135, 137; see variants of the day signs cib and caban in codices. The dotted aspirate line also appears as one of its components, Figs. 63 and 66 = cha. From the element, Fig. 113 and Fig. 127, we obtain the word caban, suggesting cab, and this prefixed to the il curve, Fig. 126, gives cabil = "honey." The glyphs underneath this compound glyph are variants of Figs. 118 and 119 and = cha. The element placed between is a variant of Fig. 63, with the vowel element = a above; one of its phonetic values is also cha. The glyph to the right is the prefix Fig. 93 = in this case, u. We, therefore, obtain the suggestion u-cabil = "honey" or "sweets." Cha. is repeated several times. In certain glyphs we frequently find repetitions of certain sounds as if the scribe desired to prevent any mistake in the meaning of the glyph, or else considered their addition as phonetic elements improved the appearance of the glyph. It cannot be denied that the arrangement of the phonetic elements composing these glyphs has a high degree of artistic excellence. The l curve, Fig. 126, in the glyph just analyzed, is combined with Fig. 53, one of whose values is i. We see given in glyphs Figs. 128 and 129 (refer to Plate 22* Troano) appearing in connection with the representation of an armadillo caught beneath a trap. On the top of the wooden bars composing the trap are three glyphs shown in my Fig 136. It has for component parts three small squares, variants of Fig. 35ª, one of whose values = cha. Joined to it is the l curve, see Figs. 126 and 130, giving chal. The element Fig. 74 is represented = cha v-s or xa v-s, cha v-s, from which we obtain by vowel fluctuation che or xe; suffixing this to chal or xal we obtain chalche. The glyphs, Figs. 128 and 129, either represent pieces of calcareous rock, chalche, placed upon the bars of the trap, or else the word is used to recall the word che = "wood." The glyph itself may represent round bars of wood calche that have been sawed across and laid on top of the trap or cage drawn by the scribe. If the interpretation "wooden bar" be accepted it coincides with and proves the interpretation of Dr. Thomas to be correct. The method herein set forth, in fact, coincides in its results with many of the interpretations made by my colleague of the Bureau of Ethnology, Dr. Thomas, and one method of procedure is, in fact, but a check upon the other.

Figs. 131 and 132 = Co or ku v-s, chu v-s (see day sign chuen). In the day sign akbal these same elements appear placed in a perpendicular position. Its value, instead of being ku or chu, as in chuen, is ak or ach, derived from ku v-s or chu v-s, thus: ka, ke, ki, ko; ak, ek, ik, ok. It is an excellent example of how the same elements appear in new combinations with different phonetic values, these being influenced by vowel fluctuation.

Figs. 146, 147 = Uch v-s.
Fig. 148 = Ka v-s.
Figs. 149, 150 = Kan, ka v-s, an v-s.
Fig. 151 = Yox, iax, yosh, iash, sh, h, xa v-s. The value of this element will be demonstrated in Part II. of this article.

The phonetic values assigned a series of elements having been given, let me proceed to apply some of them to certain glyphs beginning with Fig. 160. This glyph, and variants of it, is frequently found in the codices in connection with a figure which has been designated, for the sake of convenience, "The Long-Nosed God," whom there is good reason to think is kukulkan. A glance at this glyph shows it to be a representation of an elongated reptile-like head, an ideographic suggestion of the serpent god. In the nose we have the elements, Fig. 105 = cha, curved around into a loop-like end, Fig. 161. The mouth line must not be confounded with the parallel earth line. At times small tooth-like squares (Figs. 28, 29, 30) are attached to it—similar to those shown in our Figs. 31 and 34. They seem like phonetic additions placed to indicate the especial phonetic value of the element to which they are attached. In this case there are two squares attached = ca. As chi = "mout" we accept the suggestion as cha or kha (c = k in Maya). It will be observed that the end of the mouth line is somewhat curved upward (see Fig. 162). It might at first be thought the result of accident but an examination of other glyphs (Figs. 171 and 181) shows that this is not the case. Figs. 181, 186, 187, show the mouth element, Fig. 185, connected with a curved line, a motive derived from the life line of the serpent kan, Fig. 192. This line, Fig. 187 a and Fig. 133 has the phonetic value of kan, ka v-s, an v-s. Chan is the evident phonetic value represented by our element, Fig. 162. We shall see it repeated with like value in other face glyphs yet to be analyzed. Fig. 163 we have assigned the phonetic value of uch v-s, and by vowel fluctuation we obtain cha (see values assigned Figs. 146, 147). The element Fig. 167 = cha or kha or ka. The element shown in Fig. 165 is composed of the perpendicular line, Fig. 1 = ka, and the twisted line, Fig. 135 and Fig. 153ª = ban v-s, ba v-s an, b; its value an is here used, which, placed after ka, = kan or kaan. Fig. 165 by reference to the list at Fig. 45 = o or u. Fig. 166 = cha; it is a variant of the ch'i glyph, Figs. 92 and 93, 114, 115, 116, 117. The Fig. 168 has a like value, as our element Fig. 99 = chan or kan. The components, Figs. 169, 170, 170ª, by reference to Figs. 7, 8, will be seen to have the value of ka or ca. All of the elements composing this glyph are kan elements recalling "chu-cha-chan" or kukakan.

Fig. 171 from the Codex Cortesianus is composed of a similar series of kan elements, the three perpendicular black dots to the right of it repeating xo (= three) or chu; so is Fig. 181 with its components, Figs. 182, 183, 184, 185, 187; all kan elements arranged into a face glyph.

In Fig. 172 we have another important face glyph which is a composite of kan elements. Curving upward around the mouth (= ch'i) Fig. 172ᶜ is the an curve, Fig. 84, recalling chan. The element in the nose position, Fig. 173, = cha; see Figs. 109, 110, 111. The curved line, Fig. 174, = cha. It is a variant of Figs. 87 and 88 in my list and appears in many different combinations with this value. Some of them will be demonstrated in Part II. of this article. Fig. 175 has already been used, as cha v-s in Fig. 160. The same phonetic value is represented here. Fig. 176 is a series of Figs. 1 and 2 = ka, and Fig. 177 are variants of Figs. 12 and 13, 14 = an, giving kan. All the elements in this face glyph are kan elements. Where the dotted line Fig. 172ª is prefixed to the glyph it gives the hissing sound of x, sh, or ch and the glyph becomes xan or chan.

Fig. 178 has as one of its components a variant of the kan glyph, Fig. 172. The face or head is represented in the act of sucking the nipple of a breast. Hoobnelil, Fig. 179. Inside of the outline of the breast, Fig. 179, is the ah prefix, Fig. 180. We have thus recalled by the prefix ah, by the representation of a breast, hoobnil, and by the glyph, a variant of Fig. 172, = kan, the name of the bacab or chak, who represents the cardinal point south, = ah-Hoobnil-kan. The glyph is taken from the series, Codex Troano, Plate 25*, and proves the assignment made by De Rosny to be correct. It is an excellent example of the ikonomatic method of writing used by the ancient Mayas, a similar method being used by the ancient Mexicans, and to use the words of Dr. D. G. Brinton in a letter received by me from that distinguished Americanist, "hence it probably obtained in the Maya."

[*To be continued.*]

DOUBLE SURFACES.

BY HENRY L. COAR, CAMBRIDGE, MASS.

The double surface was discovered by Moebius, probably about 1858, and he called attention to some of the peculiarities of the surface as he constructed it, and which has been called after his name, "Blatt des Möebius." Since his time this surface has been studied to some extent, especially by German mathematicians, and many forms of the double surface have been found beside that of Moebius. The most recent work on the subject is by F. Dingledey—"Topologische Studien über die aus ringförmig geschlossenen Bändern durch gewisse Schnitte erzeugbaren Gebilde" (Leipzig, 1890). In this work Dingledey gives a pretty complete bibliography of the subject. The existence of these surfaces is, however, little known, and it may be of interest to describe the simplest form, aside from any mathematical interest which may be attached to the subject.

The simplest form of a double surface may be constructed as follows: Take a strip of paper, whose edges we will denote as in the figure by AB and CD, and bend it imto a ring, at the same time revolving one end through 180°, so that B will fall on C and D fall on A. Now glue

the two ends together. We shall then obtain a band, which has the distinctive properties that it is bounded by only one edge and has only one surface. In other words, we can pass from any point in the surface of the paper to the corresponding point on the other side of the paper without crossing the edge. This is the simplest form of a double surface.

If, now, we cut our band along the line marked EF in the figure, it will drop apart into a new band of twice the length of the former band, but the new band will no longer be a double surface. The reason for this is obvious.

In the original band we could pass continuously along the edge from B to A (= D) to C (= B) back to our starting point. Now, in cutting along the line EF we nowhere cross this continuous edge, so that it will remain an edge of the new surface, while the cut will form a second edge of the new surface. We have thus removed one of the distinctive characteristics of the double surface, by having a surface bounded by two lines. Furthermore, it will be impossible to pass in the new band from a point on one side of the paper to the corresponding point on the opposite side without crossing the edge. The reason for this will be more obvious in the following:

In forming the double service we revolved one end of the strip of paper through an angle of 180°, about, say, the point E, or, better, the line EF. It is clear now that if, instead of revolving it through an angle of 180°, we had revolved it through an angle of 2x180°, the point B would have fallen on A and D on C, so that we should have two continuous edges to our surface, and it will no longer be a double surface. We can then say, in general, that if we revolve the end of the strip of paper through an odd multiple of 180°, before fastening the two ends together, we shall always obtain a double surface, whereas if we revolve through an even multiple of 180° we have an ordinary surface. By this means we can distinguish double surfaces from ordinary surfaces.

We will now return to the surface obtained by cutting the double surface along the line EF and see why it must be an ordinary surface. The double surface originally had a twist of 180°. Suppose, now, we have cut it as indicated, but do not let the ends drop apart; then each part on either side of the cut will have a twist of 180°, or, together, 2x180°. If we let the surface fall apart we double the twists again, and our new surface has a twist of 4x180°, and it is therefore an ordinary surface. That this is so may be easily verified by cutting the band across and revolving one end until the strip has no twists, when it will be found that it has to be revolved through 4x180°.

If we cut a double surface obtained by rotating through 3x180° along the line EF, we shall find that we have introduced a knot in our new surface, which in other respects will, however, be an ordinary surface. These knots will be multiplied, as we proceed, to surfaces containing a higher number of twists.

It is easy to see that if we cut an ordinary surface, obtained by revolving the end of our paper through 2x180°, along the line EF, we shall obtain two ordinary surfaces, which are, however, interlinked. The same holds for surfaces with a higher number of twists, where, however, the interlinking becomes more complicated.

Another interesting set of results may be obtained by cutting the surfaces along a line parallel to the edge at a distance from the edge less than one-half the width of the strip of paper. The results will be different in the case of double and ordinary surfaces.

BOTANICAL NOTES FROM WESTERN PENNSYLVANIA.

BY HUBERT LYMAN CLARK, PITTSBURGH, PA.

On looking over my field notes for the spring and summer of 1893, I find there are a few facts the preservation of which may be worth while, in the hope that before long some competent botanist will prepare an annotated list of the plants of western Pennsylvania. There is not at present, so far as I know, any such list, and its appearance would be welcomed by all our local botanists. Whenever the work is undertaken it will be desirable to have as much material in available form as possible, and so I have presumed to publish my important notes in *Science*, hoping they will also prove of interest to botanists elsewhere.

On analyzing specimens of *Delphinium* from the country around Pittsburgh last spring, I was struck with the rich coloring of the flowers. There was not the least doubt about the plant being *D. tricome*, but, to my surprise, Gray's "Manual" says the flowers of *D. tricome* are "bright-blue, sometimes white," while every specimen which I examined had "royal purple" flowers. Thinking that the trouble might be in my sense of color, I looked through the "Manual" for other "bright-blue" flowers. I found *Aster undulatus*, *Chicorium intybus* and *Campanula rotundifolia* so given, and I should certainly call them so, but the *Delphinium* of this vicinity has flowers of the same color as *Liatris scariosa*, which Gray calls "rose-purple," or perhaps nearer to *Aster novæ-angliæ*, which is given as "violet-purple." Never having seen *Delphinium* growing elsewhere, I am curious to know if in other parts of its range it really does bear flowers similar in color to *Chic.rium* or *Campanula*, or whether it is not a slip of the pen in the "Manual" to describe them as "bright-blue." In the same work (which is perfectly invaluable to an amateur botanist in the east) *Silene nivea* is recorded as "rare," and it is with great pleasure, therefore, that I can report it as abundant in several places around Pittsburgh. Indeed, I am inclined to think it is the most common representative of its genus in this neighborhood.

None of the botanists whom I have consulted record *Trifolium stoloniferum* east of Ohio, and it is therefore very pleasant to be able to record it from Pittsburgh. On the 8th of last June I found it growing in an open space in some woods about six miles east of the city. While it is of course possible that it has been introduced, it was growing so far from any house or highway as to certainly appear indigenous. There is no specimen of this clover in the herbarium of the Western Pennsylvania Botanical Society, and I am inclined to think this is the first record for the State.

Gnaphalium purpureum is reported in the "Manual" to occur in "sandy or gravelly soil, coast of Maine to Virginia and southward." It is not very clear from this how far inland we may expect to find it, but certainly the implication is that it is a seashore plant It may be worth while, therefore, to record that it is not very rare around Pittsburgh, three hundred and fifty miles from the coast! I found it growing in Arlington, twelve miles south of the city, in June last, and there are a number of specimens in the herbarium of the botanical society to which reference has been made. These specimens are from widely-scattered points in the county, and would seem to indicate regular and not uncommon occurrence. One of the most abundant weeds in many parts of Pittsburgh is a species of *Galinsoga*, differing from *G. parviflora* in the scales of the pappus and being very hairy instead of smoothish. Dr. Robinson, of the Gray Herbarium, Cambridge, to whom I am indebted for many favors, kindly identified the specimens sent to him as "a possible variety of *G. hispida*," or at least so it may be considered provisionally. Similar specimens are reported from Milwaukee and Providence. Whether *G. parviflora* occurs in Pittsburgh I cannot say, but I have not yet found any specimens agreeing with the description in the "Manual." Another plant which Dr. Robinson identified for me is also an introduced species reported in the "Manual" as "rather rare; in cultivated grounds." I refer to *Veronica arvensis*, two specimens of which I sent to Cambridge, supposing them to represent different species, they were so unlike. One of them was collected in open pasture land, and I found similar specimens in other places of a like nature. It appears like an introduced species, and I suspected it was *V. arvensis*. So far as I know, it has not been previously recorded here, and there is no specimen in the herbarium of the botanical society. The other specimen also referred to *V arvensis* was collected in the Allegheny Mountains near Altoona, and differed from the first in the size, shape and abundance of the leaves. It was growing on a hillside in the woods, far from any house or road and at some distance from cultivated ground, so that it appeared to be indigenous.

LETTERS TO THE EDITOR.

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

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

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

Feigned Death in Snakes.

It was I who suggested to Professor Kilpatrick the possibility of the apparent biting of itself by *Heterodon* being in mimicry of that which was claimed for the rattlesnake. But I do not at all *know* that the rattlesnake *has* any such habit. I have often heard it from the herdsmen on our prairies in an early day concerning our short Massassaugas, *Caudisona tergemina* (Cope). I have repeatedly heard persons say that they had taken a small switch and teased a rattlesnake till, in its anger, it would bite itself and die. But after reading Dr. Mitchell's statement that he had often injected the snake's own poison into its circulation without any apparent effect, I grew skeptical on the suicide theory. Professor Kilpatrick's narration to me recalled the traditions, and, knowing that this spread-head often mimicked the ways of poisonous kinds, it occurred to me this might be another manifestation. Cannot someone inform us whether it be true that any of the Crotalidæ have, or pretend to have, this suicidal habit, and can we not have some further statements from herpologists as to whether in any serpent its poison is fatal to itself or its fellows? Analogy would indicate that it might be. Bee stings are fatal to each other, and it seems well established that scorpions commit suicide by their own stings under certain circumstances of torment.

Apropos of the conduct of Professor Kilpatrick's snakes being a "*faint*, instead of a *feint*," it is perhaps well known that Dr. C. C. Abbott, in "Rambles About Home," claims that the similar conduct of the opossum is really a spasm from fear (rendering the creature unconscious), instead of a shamming of death.

J. N. Baskett.

Mexico, Mo.

A Peculiar Flora in Chicago.

While in Chicago last July I spent some little time in botanizing in the vicinity of the Fair grounds, and I was much struck with the peculiar flora of two vacant lots in that neighborhood. One of these is at the corner of Oglesby avenue and Sixty-second street, and is very dry with the grass cropped short by grazing animals. Here I was surprised to find the ground covered with *Potentilla anserina*, which I have never found previously in any but very marshy places. Indeed, until I had analyzed it, I could scarcely believe that it was not some other species. The plants were all very dwarfed, presumably from their unfavorable environment, but otherwise agreed perfectly with *P. anserina* from other localities. On the edge of this same lot was a thriving specimen of *Habenaria leucophaea*, also a plant of the marshes, and so out of place here. I am inclined to think, therefore, that before the extension of the city so far south these lots were marshes and the plants are but survivors of the former flora.

In the other lot, however, at the corner of Woodlawn avenue and Fifty-ninth street, the peculiar flora does not admit of as easy an explanation. In this field the soil was rich and moist (though nowhere wet) and covered with a good growth of grass and sedges. Here I found several specimens of *Galium boreale;* and *Calamintha nuttallii* was abundant. The former, according to Gray, is an inhabitant of the "rocky banks of streams," while the latter occurs only on "wet limestone river banks." So unlikely a place did it seem for *Calamintha* that I sent a specimen to the Gray Herbarium at Cambridge, but Mr. Fernald, who very kindly examined the plant, assures me that my identification was correct. He suggests also that the species may have been introduced in that place, but I must say that this seems improbable to me. Perhaps some one more familiar with the botany of Cook County may be able to explain the occurrence of these two species in such an unlooked-for locality.

Hubert Lyman Clark.

Pittsburgh, Pa.

Eskimo Traces in New York.

Sir Daniel Wilson once suggested a connection between the Eskimo and the Iroquois, founded on physical structure. The habits of the two were so different, however, that this is probable only in a slight degree. That the Eskimo once roamed where the Iroquois afterwards lived seems certain. If the Northmen reached the shores of New England, the Eskimo must even then have dwelt along the coast, and archæology makes it probable that a large part of the Middle States had not then been occupied by the so-called Indian tribes.

The recent collections made far north have been especially interesting to me as bearing upon some relics found in New York and Canada, and in a less degree in New England. The one-sided harpoon of Alaska differs in no respect from those which the Mohawks and Onondagas used three hundred years ago. The half-circular slate knives found all through the territory mentioned are like those of the Eskimo women now. The Ninth Report of the Bureau of Ethnology contains other suggestive material. Through central New York, in portions of the Province of Ontario, in Canada, and along Lake Champlain occur double-edged polished slate knives, arrow-like in form, almost identical with those on page 151 of the report and some following pages. Rarely have I seen them single-edged, and, as they usually occur near streams, I have thought they were used in opening and cleaning fish. Almost all those I have seen in New York and Canada have slight barbs, a feature which seems lacking in the Eskimo knife. With us they are made of various kinds of slate, and I have one very broad form of red slate. Usually they are dark grey. The flat tong is always bevelled, and often notched. A very delicate and beautiful one I recently figured from the Oneida River.

If the Iroquois used combs at all before European contact, they were very simple, but some of their later examples remind one of those of the Eskimo under similar circumstances. The wooden and horn spoons are also suggestive, the broad wooden spoon occurring among the Onondagas yet. In both cases these may be due to a new environment. The flat soapstone vessels, with their many perforations, are earlier in New York than the Iroquois occupancy, and altogether apart from it. Many of them have handles, and they occur along the larger streams. The material is not found in the State, as far as I remember, and they seem to have been brought here by fishing parties. The common forms are like some Eskimo vessels.

The figure on page 136, representing a man's belt, is of special interest, as showing the reputed form and material of the primitive Iroquois council belt, afterwards made of wampum. The foundation of this Eskimo belt is like that of a wampum belt, but quills, or shafts of feathers, form the pattern instead of beads. Now, it is a clearly proved fact that the Iroquois and their predecessors in New York had no shell beads suitable for belts, and very few at all. Loskiel said that they used small colored sticks. In a paper on "Hiawatha," and in my "Iroquois Trail," I have given some Iroquois stories on their first use of wampum, in some of which the wampum bird figures. One of these represents Hiawatha stringing the quills of the legendary black eagle. The Mohawk chief, however, cannot call down the sacred bird, and sends a string of partridge quills in return. An Onondaga told me that their early belts were made of the quills of birds or of porcupines, which were afterwards replaced with beads. The latter have been found on no early sites, and are quite modern with them. W. M. BEAUCHAMP.

Baldwinsville, N. Y., Dec. 4, 1893.

A MINIATURE WATER LILY.

DURING an extended tour the past summer in northern Minnesota I came upon a beautiful little white water lily. It is an almost exact miniature of *Nymphea odorata*. The flowers are about an inch and a half across. The leaves are oval-sagittate, three-fourths inches long. I found it only on the south branch of the Tamarack river, which flows into the northeast corner of Red Lake. It is there quite abundant. Can any of your readers give more information concerning it? J. E. TODD.

University of South Dakota, Dec. 1.

FEIGNED DEATH IN SNAKES.

IN *Science* for Nov. 3 is an article on "Feigned Death in Snakes." Probably the writer is correct in his statement that the Heterodon does not (usually) bite himself just before feigning death. I recall one instance, however, in which a large black blowing viper, in the act of feigning death, contrived somehow to get his teeth (such as they were) caught in the skin on his side, and he was lying thus when I picked him up and loosed the teeth. This may have been accidental. I have often tried to get these snakes to bite something—anything—my hand, for instance, and never succeeded. But I have occasionally had one of them strike me a sharp rap with the end of his nose—of course without doing any damage. Moreover, I have not observed that they *usually* eject the contents of the stomach. When one of them has recently swallowed something, especially if it is something bulky, he will often (perhaps always) eject it before trying to escape or feigning death. But otherwise, my observation has not led me to believe that it is a common practice.

However, the thing that I especially desired to hear about was the action of rattlesnakes under similar circumstances. I have never seen a rattlesnake feign death, but reliable parties have reported the fact; only they generally speak of it as the snake killing himself. For they all state that the rattlesnake does bite himself and then seems to die. (The quickness with which they appear to die is suspicious). Now Dr. Mitchell states, after much study and experiment with the poison of snakes, that the poison of a rattlesnake injected under the skin of the same animal does not cause death. It is about these animals and their apparently pretended suicide that I would much like to hear. J. W. KILPATRICK.

Fayette, Mo., Dec. 1.

DR. TOPINARD AND THE SERPENT MOUND.

IN the November 10th issue of *Science* Dr. Brinton has very properly replied to Dr. Paul Topinard, the eminent French anthropologist. American students, who have been so frequently told how much more the French know concerning prehistoric archæology than the scientists of this country, will find a great deal of satisfaction in noting the ignorance which the great savant Dr. Topinard displays in his article. I wish to call the attention of the readers of *Science* to the fact that, while Squier and Davis published an excellent map of the Serpent Mound (in Adams County, Ohio), Caleb Atwater wrote concerning it in 1820. So the eminent Frenchman has made a mistake of about sixty years in attributing the discovery to Professor Putnam. One can easily understand and overlook a mistake in locating or describing the small earthworks or western ruins on the part of the distinguished foreigner, but, after all that has been published about our greatest monument, the Serpent Mound, it is very strange that one whose entire life has been given to the study of prehistoric peoples should have fallen into such an error regarding it. WARREN K. MOOREHEAD.

THE HARDNESS OF CARBORUNDUM.

REFERRING to my article on "Carborundum" (*Science*, XXII., 141), it is there stated that the discoverer of this substance claimed that it would cut and polish the diamond. In the December number of the *Am. Jour. Sci.*, XLVI., 473, Mr. G. F. Kunz states the result of an experiment made by him to determine this. A new wheel was provided, and, after several trials, it was found that the carborundum, though hard enough to cut sapphire and corundum, would not cut or polish the diamond. The carborundum crystals may be scratched by diamond points. The hardness is thus between 9 and 10, and it is, next to the diamond, the hardest substance known.

WM. P. BLAKE.

LATE-BLOOMING TREES.

WHILE at Brielle, N. J., I noticed, during the first week in September, several apple trees blooming quite freshly, and I have reports from Alpine, N. J., of pear trees and horse chestnuts being in bloom. Can any of your readers give an explanation of the cause and the effects (upon the trees) of this occurrence?

WALTER MENDELSON.

New York City.

TELLURIDE OF GOLD, CRIPPLE CREEK, COLORADO.

THE native gold of Cripple Creek, whether obtained from the placers or from the veins, is remarkably fine, being worth twenty dollars, or more, per ounce. It contains very little silver, and appears to be derived from a telluride allied to, if not identical with, the species calaverite, which contains about 41 per cent. of gold. The telluride is silver white, and is in prismatic crystals, much striated. In the oxidized ores the tellurium has leached out and left the gold behind in a spongy condition, but retaining the form of the original crystal A purple-colored fluorite in small cubic crystals is a common associate of the telluride. The rocks of the district are mostly granitic. The ores of high grade are successfully worked by smelting, rather than by milling.

WM. P BLAKE.

New Haven, Conn.

BOOK-REVIEWS.

A Pocket Key to the Birds of the Northern United States. By A. C. APGAR. Trenton, N. J., John L. Murphy. 50 p., 50 cents.

THIS small book, which can readily be carried in one's pocket, gives a simple, usable key which will enable a student of nature to determine the family and usually the genera of any of our northern birds. It will be especially valuable as a field book for one to carry in short excursions.

The Soil in Relation to Health. By H. A. MIERS, F. G. S., F. C. S., and R. CROSKEY, D. P. H. New York, Macmillan & Co. 130 p., $1.10.

As the result of the recent advance in matters of hygiene many short accounts of the hygienic characteristics of water and milk have been presented to the public. The suggestion of soil in relation to health is a somewhat new one. At the same time, it is perhaps as old as any in general estimation, for every one has some conception that certain kinds of soils are not healthful. In this little volume of 130 pages are collected all of the general facts known in relation to the hygiene of the soil. It is discussed especially in connection with the subjects of the water in the soil, the air in the soil and micro-organisms in the soil. The relation of the soil in the distribution of most important diseases is discussed, and the relation of ground water to all phenomena of health is considered carefully. In short, this little volume presents the factors which should be considered in determining the healthfulness of any locality, so far as concerns its soil.

The Inadequacy of "Natural Selection." By HERBERT SPENCER. New York, D. Appleton & Co.

IN this little pamphlet have been republished the three essays on the subject of Weismannism published by Herbert Spencer in the *Contemporary Review* in 1893. These trenchant criticisms of Weismann's theory are well known and need no comment. In this form the essays form a valuable addition to any library on the subject of recent views of heredity.

The Native Calendar of Mexico and Central America: A Study in Linguistics and Symbolism. By DANIEL G. BRINTON, M.D., LL.D. Philadelphia, David McKay.

THERE is probably no question more important in American archæology, and none more obscure, than that of the calendar in use by the natives of Mexico and Central America before the Spanish conquest. Up to the present time its solution has foiled every student, from Humboldt down.

In the essay before us the author does not take up the mathematical and astronomical problems involved, but aims to define the geographical extension of the calendar, its probable origin and its symbolic meaning. His results may be briefly stated. The same calendar system is shown to have prevailed among all the semi-civilized nations of Mexico and Central America ; its origin, he inclines to think, was among that branch of the Mayan tribes which dwelt near the great ruins of Palenque and Ocozingo, and built those cities; and it arose at first not as a time-measure, but as a means of astrological divination, and only later was brought into relation to the luni-solar year-counts of the tribes who adopted it. Its essentially symbolic character is explained at considerable length; and the etymology of the day and month names in the different languages is presented with greater fullness than has hitherto been attempted.

A Theory of Development and Heredity. By HENRY B. ORR, Ph. D. NewYork, Macmillan & Co. 255 p.

ANY new presentation of the subject of heredity is welcome, for in recent years biological discussion has become so intimately associated with this subject that there is a general impression among students that no further advance along the lines of biological truth is possible until this problem of heredity is in a measure solved. Prof. Orr, of Tulane University, has endeavored to give us a new view upon the subject of development and heredity. His theory, while not absolutely new, perhaps, is certainly fresh and novel in its applications, and in its association of facts somewhat widely distinct and hitherto kept separate.

The theory of Prof. Orr has in it some of the features of Weismann, inasmuch as it is based upon the supposed continuity of germ plasm, but differs radically from Weismann's theory in assuming the possible and, indeed, the necessary modification of this germ plasm, by the conditions surrounding the adult. The theory is in reality an expansion of the old statement of Haeckel that heredity is memory. The phenomena of heredity and development are based by Prof. Orr wholly upon the nervous system of organisms, and this nervous system he traces through the lower organisms, and even extends it through the vegetable kingdom, thus finding the essential features of the nervous system co-existent with life. Heredity is habit; the germ substance is continuous from generation to generation, and its nervous factors remember. Great stress is placed upon the known facts of the acquirement through habit of reflex actions by the nervous system of the higher vertebrates, and a similar action is supposed to be possessed in all protoplasm. The theory assumes that protoplasm, like other matter, is extremely plastic and undergoes physical or molecular modifications with every action of the environment upon it. Acquired characters of the adult affect all the protoplasm of the body, including the germ plasm, and form thus the most important basis of modification and development. The theory, in short, is an attempt to show that heredity is due to slow modifications of the nervous system of the germ plasm, produced upon it by changed conditions, and applies equally to the body protoplasm or the germ plasm.

The view of Prof. Orr is suggestive, but it is doubtful if it explains very much. If Weismann's theory became popular and spread all over the world rapidly because of its simplicity and ready comprehension, it is safe to say that Prof. Orr's theory will not have a like history. The theory itself is a little more difficult to understand than it is to understand heredity without it, for to explain everything by a nervous system whose very presence is, in lower organisms, a matter of hypothesis, does not advance us very much on the line of simplicity. If Prof. Orr's theory is true, it is certain that biologists are not ready for it, because it relegates the whole subject of heredity and development to that one branch of biology of which we professedly know least, namely, that of mind. In spite of this, the discussion of Prof. Orr is full of suggestion, and will undoubtedly repay thorough reading and careful thought on the part of any student of nature.

Method and Results. By THOMAS H. HUXLEY. New York, D. Appleton & Co. 8vo., $1.25.

THIS book is the first of a series of nine bearing the general title of "Collected Essays," in which Prof. Huxley intends to gather together his scattered essays and addresses in a permanent form. One of the essays in this volume relates to Desecartes' "Discourse on Method," and is designed to set forth Prof. Huxley's own views as to the right method of scientific investigation ; while the other essays, according to the preface, show the results of this method as applied to various questions. Hence he has entitled the book "Method and Results," but the various essays are so heterogeneous in character that the reader is likely to think that almost any other title would have served about as well. The book opens with a brief autobiography, which will interest the author's admirers for the account it gives of his early life and education; but it has little to say of his later scientific activity or of the many controversies in which he has been engaged. The longest paper of those here collected is that on "The Progress of Science," which was published at the time of Queen Victoria's jubilee, and with which the readers of this journal are doubtless familiar. Of the remaining essays several, of which the earliest is dated 1866, relate to physical science and the importance of cultivating it; while no less than four, mostly of recent date, are concerned with political topics. The main object of the latter is to set forth Mr. Huxley's views on the much debated question of socialism against individualism, as to which he occupies a middle ground in opposition to the extreme doctrines of both parties. He fails, however, to lay down any principle for the practical guidance of statesmen which will enable them to steer wisely and safely between the two; while much that he says about Rousseau and the social contract, though for the most part true enough, is merely a threshing of old straw. The whole book is marked by the vigor and earnestness that characterize all of Mr. Huxley's writings, as well as by that positiveness that he usually shows even when expressing the most "agnostic" opinions. The whole series of volumes, of which this is the first, will consist, we suppose, of works that have been published in some form before; but they will be handsomely printed, and readers will like to have the essays in a collected form.

Catalogue of Section One of the Museum of the Geological Survey, Embracing the Systematic Collection of Minerals and the Collections of Economic Minerals and Rocks and Specimens Illustrative of Structural Geology. By G. Christian Hoffman, F. Inst. Chem., F. R. S. C. Printed by F. E. Dawson. Ten cents.

The recently issued catalogue of section one of the museum of the Geological Survey of Canada embraces the systematic collection of minerals, and those of economic minerals and rocks, as well as a smaller series illustrative of structural phenomena. From it we learn that the collections comprise between 6,000 and 7,000 specimens. The systematic series is arranged in accordance with the classification employed in the latest edition of Dana's Mineralogy. The economic series is arranged as in the following synopsis: I. Metals and Their Ores. II. Minerals Applicable to Certain Chemical Manufactures. III. Minerals Used in the Production of Light and Heat. IV. Minerals (and Material Manufactured from Certain of the Same) Applicable to Common and Decorative Construction. V. Minerals Employed as Pigments. VI. Refractory (Fire Resisting) Minerals. VII. Brines, Salt and Mineral Waters. VIII. Minerals Applicable to the Fine Arts and to Jewelry. IX. Minerals Employed, with or without Previous Preparation, as Fertilizers. X. Minerals Employed for Grinding and Polishing. XI. Minerals of Miscellaneous Application.

The arrangement as above outlined is not wholly free from defects, but the present writer will venture the assertion that no one who has himself wrestled with the problem of museum installation will be inclined to criticize it too harshly. It will be always an open question as to whether, in such cases, material had best be arranged by kinds, and their use indicated by labels and handbooks, or whether we should attempt to classify according to usage, as above. The first method is much the easier, and to the systematic student the more useful since it involves much less duplication of material. Unfortunately the visiting public usually prefer seeing specimens to reading labels; at least the specimen must be seen first. Hence some such arrangement as that adopted by the Canadian Survey seems most nearly to meet their wants, though it must be acknowledged that it is wasteful of both space and materials, and vastly more troublesome in carrying out. The mineral quartz well illustrates this point. In its various forms it is used for optical purposes; in jewelry; as an abrading material; in the manufacture of glass, china or earthenware; as an adulterant in paints, and (in the form of sand) in mortar and brick making. This involves a duplication and reduplication of materials and labels which is at least trying. Concerning the effectiveness of the exhibit, naturally nothing can be learned merely from a perusal of a catalogue without illustrations other than a diagram of the exhibition hall. The least that can be said, is that it shows a very pains-taking and commendable attempt at making the work of the survey available to the public.

Examen Sommaire des Boissons Falsifiées. Par Alex. Hébart, Préparateur aux travaux pratiques de Chimie à l'Ecole de Médecine. Paris, Gauthier-Villars et Fils. 171 p. 1893. (Broché 2 fr 50c. Cartonné 3 fr.)

In this work is comprised a study of the more frequent of the adulterations with which many modern manufacturers load our wines and other table liquors. M. Hébart has aimed to produce a work for the educated public and for the amateur, which will be at once readable and intelligible to all of even elementary acquaintance with the science of chemistry. Unlike some other books of like intention, this manner of treatment has not drawn from the scientific usefulness of the work, and while many theoretically and practically difficult methods of analysis are omitted those which are described are admirable for their accuracy and applicability. A large number of important facts are advanced in the five chapters devoted successively to wines, ciders, beers, brandy and liquors, and vinegar, and at the same time many popular fancies regarding the adulterations of these liquids are exposed. In general terms the treatment in each of the above named chapters is as follows: First, a discussion of the history and composition of the crude material and finished products; second, a summary of the different varieties produced, and, third, a study of the adulterations and their characteristics, with particular attention given to those forms of adulteration which are most commonly met with. A popular exposition of scientific facts treated successfully in a scientific manner is sufficiently rare to make this work of M. Hébart's unique and of considerable value.

A Laboratory Guide for a Twenty Weeks' Course in General Chemistry. By George Willard B nt n, A. M., Instructor in Chemistry, High School, and Chemist for the City of Indianapolis, Ind. Boston, D. C. Heath & Co. 163 p. 1893.

This little book is designed as an aid to the student in elementary chemistry and is addressed to him alone, with words of advice as to chemical manipulation and laboratory methods. The experiments (over 150 in number) are systematically arranged and are so placed before the pupil as to aid him in drawing his own conclusions by logical deductions from the facts observed. Methods of measurement, the comparison of physical and chemical change, the properties of the non-metals, their compounds, and the metals are illustrated in succession and with simplicity. In several cases the experiments have, however, been rather injudiciously chosen; as, for instance, experiment 7, coming under the head of "Various Ways of Inducing Chemical Change." The student is told to mix together potassium chlorate, sugar, and concentrated sulphuric acid, these directions being followed by an interrogation mark, which is presumably intended to elicit from the student an explanation of what has taken place. An exclamation point would, however, seem more suitable after such an experiment!

NOTES AND NEWS.

On Dec. 5 Professor William H. Holmes read a paper before the Anthropological Society of Washington, in which he connected some types of pottery from the extreme southern states with that of the Caribs, by means of the peculiar style of ornamentation, observed also on the wood-carving described in Prof. O. T. Mason's pamphlets on the Latimer collection and the Guesde collection. In this same connection it is interesting to recall the observations of Prof. Jeffreys Wyman upon the evidence of cannibalism in the shell-heaps of the St. John's River, east Florida. Professor Wyman first came upon these evidences in 1861 and the results are stated in the seventh annual report of the Peabody Museum, published in 1874. With this bit of evidence, connecting the Caribs with southeastern United States, should also be associated the practice of some southern tribes of weaving a band of cotton or other textile above the calf of the leg so as to increase the size of the limb. This was practised by the Caribs also. Not much weight should be given to the co-existence among the Caribs and the southern tribes of the sarbacan and the blow-tube, because the last-named apparatus might be found wherever good straight reeds occur. The Cherokees, the Choctaws, the Chetimachas, the Attacapas, and perhaps some other tribes, make use of this weapon. It is interesting to mark that the Chetimachas anticipated the invention of the revolving fire-arm by employing the compound blow-tube made by fastening four or more canes together, as the tubes in an organ or pan-pipe. Perhaps no one of these fragments would absolutely identify the Caribs with the southeastern Indians, but it would seem strange if a people who could navigate the Caribbean Sea in large open boats were incapable of crossing from Cuba to Florida.

—*Nature* announces the death of Baron von Bülow, at Kiel. Von Bülow's Observatory, better known, perhaps, as Bothkamp Observatory, was the first in Germany devoted to astro-physical researches, and it stands as a splendid monument to his interest in astronomy. By his death astronomical physics has lost one of its most enthusiastic supporters.

—Macmillan & Co. will publish very shortly a work on "Mental Development in the Child and the Race," by Prof. J. Mark Baldwin, of Princeton, editor of the *Psychological Review* and author of the "Hand-Book of Psychology," etc. This book is to be a contribution to genetic and comparative psychology. It will deal in detail with the child's mental growth, and with questions concerning the nature and capacities of the animal mind. Special treatment is given to the problem of the origin of the mental faculties, such as Attention, Memory, Speech, Handwriting, Imitation, Volition. Although the book is to be mainly scientific in its method and results, the author hopes to interest teachers of a psychological turn by such chapters as Educational Bearings of Imitation, Social Suggestion, Habit and Accommodation, etc.

—*Wiedemann's Annalen der Physik und Chemie* for November, says *Nature*, contains an interesting paper by R Hennig, on the magnetic susceptibility of oxygen. The method employed, namely, the measurement of the displacement in a magnetic field of a short column of liquid in a slightly inclined capillary tube, due to the difference in the susceptibility of the two gases (oxygen and air) at the two ends of the liquid column, would hardly seem at first sight capable of giving very accurate values. The author, however, has obtained very fairly consistent results, and finds the value $0{\cdot}0963 \times 10^{-6}$ for the difference between the susceptibility of oxygen and air at a temperature of about 26° C., and at pressures varying from 75 cm. of mercury to 328 cm. In order to measure the strength of the magnetic field a small coil was suspended by a bifilar-suspension close to the capillary tube, and from the deflection, when a known current was passed through this coil, the strength of the field was calculated. The results obtained by this method were also compared with those found by the rotation of polarized light in a piece of heavy glass, and by means of a small induction coil which could be rapidly moved out of the field.

—Macmillan & Co. have nearly ready for publication, under the title "Pain, Pleasure and Æsthetics," an essay by Mr. H. R. Marshall concerning the psychology of pain and pleasure with special reference to æsthetics. Some parts of the argument have already been presented in the pages of *Mind*, and the author acknowledges special indebtedness to the late Prof. Croom Robertson for sympathy and encouragement.

—Some interesting investigations on the vitality of the cholera organisms on tobacco have been made by Wernicke (*Hygien: Rundschau*, 1892, No. 21), according to *Nature*. Small pieces of linen soaked in cholera broth-cultures were rolled up in various kinds of tobacco, and the latter were made into cigars. At the end of twenty-four hours only a few bacilli were found on the linen, and none on the leaf. On sterile and dry tobacco leaves, the bacilli disappeared in one-half to three hours after inoculation. On moist, unsterilized leaves they disappeared in from one to three days, but on moist and sterile leaves in from two to four days. When introduced into a five per cent. tobacco infusion (10 grams of leaves to 200 grams of water), however, they retained their vitality up to thirty-three days; but in a more concentrated infusion (one gram of leaves to two grams of water) they succumbed in twenty-four hours. When enveloped in tobacco smoke, they were destroyed, in broth-cultures, as well as in sterilized and unsterilized saliva, in five minutes. Tassinari, in his paper, "Azione del fumo di tobacco sopra alcuni microrganismi patogeni" (*Annali deli Istituto d'Igiene*, Rome, Vol. I., 1891), describes a series of experiments in which he prepared broth-cultures of different pathogenic microbes, and conducted through them the smoke from various kinds of tobacco. Out of twenty-three separate investigations, in only three were the cholera organisms alive after thirty minutes' exposure to tobacco fumes. But in actual experience the apparent antiseptic properties of tobacco have not unfrequently been met with; thus, during the influenza epidemic in 1889, Visalli (*Gazetta degli Ospedali*, 1889) mentions the remarkable immunity from this disease which characterized the operatives in tobacco manufactories; that in Genoa, for example, out of 1,200 workpeople thus engaged, not one was attacked; whilst in Rome the number was so insignificant that the works were never stopped, and no precautions were considered necessary.

—Prof. Felix Klein, of the University of Göttingen, after attending the Chicago Congress of Mathematics last August, delivered a two weeks' course of lectures on modern mathematics at Evanston, Ill., before members of the Congress. These lectures will be published (in English) substantially as they were given, with the addition of the interesting historical sketch of the development of mathematics in Germany during the present century (up to the year 1870), recently contributed by Professor Klein to the work "Die deutschen Universitäten." The lectures present, within certain limits, a general view of the most important advances that have taken place in mathematical thought and research during the last twenty-five years. Only the rare ability, possessed in so eminent a degree by Professor Klein, for taking hold of the most characteristic features of a given subject and presenting it vividly to his hearers from various points of view, could make it possible to give so much in so small a compass.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

I am desirous of obtaining the following back numbers of *The Auk*: One copy each of Oct., 1885; July, 1886; January, 1887; July, 1887; April and July, 1891 and two copies each of the following: January, 1886 Oct. 1886; Oct., 1887; July, 1888; January, 1889; January, 1890. My own contributions in them only are required; otherwise the copies need not be perfect I have in exchange for them two vols. (zoology) Mex. Bound'y Surveys (col. plates) or complete set of English reprints of "Osteology of Arctic Water-Birds, etc." (9 parts, 24 lith. plates); or other rare scientific reprints of any subject required. Address Dr. Shufeldt, Takoma, D. C.

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For exchange.—Skins of Aegialites nivosa, Ereunetes occidentalis, Aunnodramus Arldingi. A. rostratus, Chamara fasciata henshawi, etc., for native or foreign skins with full data. Send lists. A. W. Anthony, 2042 Albatross st., San Diego, California.

Wants.

WANTED.—Books or information on the microscopical determination of blood and hair. Also reports of cases where hair has played an important part in the identification of an individual. Address Maurice Reiker, 206 N. First Ave., Marshalltown, Iowa.

A GEOLOGIST thoroughly conversant with the geology ot the Southern States desires an engagement. Has complete knowledge of the economic geology of Iron, Coal, Lignite, as well as Clay and Kaolin. Five years' experience with Geological Surveys. Address K., 509 West Sixth Street, Austin, Texas.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

WANTED.—A copy of Mascart & Joubert's Lessons in Electricity and Magnetism, Vol. I. Address R. W. Clawson, Vanderbilt University, Nashville, Tennessee.

CHEMIST.—Graduate of a polytechnical school, and studied photographic chemistry in Germany and Austria. Situation teaching or in analytical or experimental laboratory. M. B. Punnett, Rochester, N. Y.

SCIENCE

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QUERY.

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

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, DECEMBER 22, 1893.

CURRENT NOTES ON ANTHROPOLOGY—NO. XXXVI.

(*Edited by D. G. Brinton, M. D., LL. D., D. Sc.*)

THE WOMAN'S ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

It is pleasant to record that this Society held its one hundredth meeting in January, 1893; and in memory of this interesting occasion, it has issued a modest pamphlet with a sketch of its industry since its organization in 1885. It has had three presidents, Mrs. Tilly E. Stevenson, Mrs. Carter and the present incumbent, Miss Alice C. Fletcher. The Society is divided into six sections, occupied respectively with the six branches, archæology, child-life study, ethnology, folk-lore, psychology and sociology. This division might be open to some question, especially as to the distinction between ethnology and sociology; but if it is found to be a good working basis, that is enough. The finances are reported in a flourishing condition, and the attendance, as well as the membership, reveals a steady advance.

So far as I am aware, there is no other anthropological society composed exclusively of women; although there are distinguished anthropologists of the female sex in many countries. It seems contrary to the true spirit of science for any scientific society to be composed exclusively of one sex. The pursuit of truth, especially that of general laws by inductive methods, should be epicene, and severed from all sex relations. The result of the opposite course in this instance is indicated by the fact that three-fourths of this report are taken up with an article on "The Woman's Movement." Good indeed, but much better fitted for a political congress than an anthropological society. When women become scientists, they should for the time forget sex in the search for truth.

THE PALAEO-ASIATICS.

This is the name given by some ethnographers—Russian and German—to a number of tribes, including the Kamschatkans, Ghiliaks, Koriaks, Youkagirs, etc., now inhabiting the islands and extreme northern and eastern coasts of Siberia; the theory being, that at one time their ancestors occupied most of northern Asia and the Japanese Archipelago, but were dispossessed by the Chinese, Mantchu, and other Mongoloid peoples. They are small in stature (about 1.50—1.60), strongly built, head round, nose flat, eyes small and oblique, hair straight, beard scanty.

Some interesting studies bearing on this question have been recently issued by Professor Gustave Schlegel, of Leyden, to whose fruitful researches in the Chinese annals I have before alluded (see *Science*, Sept. 9, 1892, March 24, 1893). He advances cogent reasons for believing the "Land of Little Men" of these ancient chronicles was Japan, and the small people from whom it derived its name were the Koriaks, who, he argues, inhabited these islands before the arrival of the Ainos, and were driven out by them. He supports this by the archæological observations of Prof. E. S. Morse, which point in this direction. The Ainos themselves, he inclines to think, are the nation referred to in the Annals as the inhabitants of "The Land of White People," and connects them with the European white race, both from the color of their skin, the character of their hair, and their full beards, traits which distinguish them broadly from their Mongolian neighbors.

Other identifications suggested by Professor Schlegel are the "Land of Gentlemen" with a part of Corea; the "Land of the East" with Kamschatka; the "Land of Profligate Devils" also with Kamschatka; and the "Land of Tall Men" with the islands of the Ainos.

THE ETRUSCAN PROBLEM.

That in the centre of the classic world a nation arose, attained a high state of civilization and remarkable artistic and literary culture, flourished for five hundred years, then disappeared, leaving some of the grandest monuments of history, and thousands of inscriptions and extensive texts in its language,—and yet that modern scholars have been unable to decipher positively a word of this language, or discover an affinity with any other nation or race,—this is certainly an unique example.

The efforts are, however, bravely continuing.

In a little-known provincial journal, the *Zeitschrift des Insterburger Alterthumsverein*, 1893, Heft III, Dr. G. Kleinschmidt has an article headed, "Zwei Lemnische Inschriften," undertaking to show that the two well-known inscriptions from the island of Lemnos, in Etruscan characters, can be interpreted by the Lithuanian and Lettish languages. As these are pure and ancient forms of Aryan speech, his argument has just as much in its favor as those of the great Etruscologist Deecke, who also claims Etruscan as an Indo-Germanic tongue.

Quite opposed to that view is the opinion—not novel—of Signor Gaetano Polari, who in a brief paper called "The New Etruscology," printed at Lugano, urges and illustrates the similarity of Etruscan to the Basque language.

Approaching the question from the side of physical anthropology, Professor Giuseppe Sergi, of Rome, in a careful article in the *Nuova Antologia*, Sept., 1893, announces that a prolonged and minute study of the genuine Etruscan remains of skulls, etc., throughout Italy, has convinced him that beyond doubt they must be classed with the Lybian stock, of North Africa. He will shortly bring out the technical demonstration of this. It gives me a natural pleasure to mention this, as the many points of similarity between the culture, religion and languages of these two peoples were first pointed out by myself,—as Professor Sergi kindly acknowledges.

THE STUDY OF FOLK-LORE IN ITALY.

Few nations can claim the wealth of folk-lore possessed by Italy, and it is a pleasure to add that no nation is more diligent in the collection and sifting of this interesting anthropologic material.

Quite recently, a new society for this purpose has been added to the considerable number of those already existing; this one at Rome, under the guidance of the distinguished Professor De Gubernatis. In Sicily, Signor Pitré has been most successful in exciting an interest in the subject, and the "Archivio per lo Studio delle Tradizioni Popolari," which he brings out, is always rich in useful observations. Our own eminent folk-lorist, Mr. Charles G. Leland, who makes his home largely in Italy, has published some most curious investigations of the survival of Etruscan rites in the superstitions of to-day in that ancient land.

In the province of Naples, Dr. Stanislas Prato, Professor in the Royal Lyceum at Lucera, is a diligent collector, and has published largely, though but little in book form. Among his essays may be mentioned a critical dissertation on the "Twelve Words of Truth," "Le Dodici

Parole della Verita," in its various forms; on a peculiarity of the Book of Tobit; on the Novelle of Cieco da Ferrara; on the Apologue of Menenius Agrippa, etc. All of these show extensive reading and sound critical judgment.

FALL MEETING OF THE ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

In December, 1890, this society was organized "for the promotion of the scientific examination and discussion of various questions of interest to the material progress of the state." The last meeting of this society was held in Birmingham on Nov. 24, when several papers of considerable interest were presented.

Mr. Murray, of the Linn Iron Works, described an improvement made by him in boilers. This improvement consists in the use of a double decked boiler with a mud drum below, and a further improvement was a modification of the Speerman-Kennedy gas burner. Mr. A. E. Barton, Superintendent of the Ensley Furnaces, read a paper "On the Grading of Southern Pig-Iron," in which he discussed the change from the old method of fifteen grades to the present one of eleven grades. He also emphasized the necessity of frequent analyses of the furnace products as an aid to the proper grading.

Mr. Erskine Ramsay, Mining Engineer at the Pratt Mines, and President of the Society, read a paper "On the Use of Coke Oven Gases and Heat in the Generation of Steam." The system in use at the Pratt Mines, which has been very carefully worked out by Mr. Ramsay, has resulted in considerable economy. The coke ovens are provided with a gas flue running the entire length of the battery through which the gases are delivered under the boilers. Mr. Ramsey showed that the heat thus utilized was merely the waste heat of the coke ovens, and that none of it was due to the combustion of the gases themselves. Attempts to utilize the heat of combustion were not successful.

Dr. William B. Phillips, consulting chemist of the Tennessee Coal, Iron and Railway Company, read a paper on the "Improvement of the Iron Ores of the Birmingham District," in which he described certain processes which he has for some time been investigating, by which it will be possible to free the red ores of the Clinton or Red Mountain formation from the greater part of the silica, as well as from most of the phosphorus. The freeing of the iron from the silica is effected by means of an electro-magnet, the ores having been previously magnetized by heating them in an atmosphere of combustible gas. Operating upon 3,000 pounds at a time, the crude ore, which contained 40 per cent of iron and 29 per cent of silica, was so improved as to yield 57 per cent of iron and only 10 per cent of silica. In some cases even better results than this have been obtained. The success of these experiments has induced the company to make a test on a large scale in one of their furnaces in Bessemer, and if successful there also (and of this there seems to be no reasonable ground for doubt), a vast amount of ore will at once become available, which is now thrown aside because carrying from 25 per cent to 35 per cent of silica.

Mr. H. F. Wilson, Jr., described some work of his in tracing the great seams of ore along the Red Mountain on both sides of Grace's Gap, illustrating his remarks by some handsome drawings and sections. This paper was a valuable supplement to that of Dr. Phillips.

The financial depression of the last year or two has left its impress upon the society, but at this last meeting nine new members were elected, and a marked increase of interest was shown in the number of papers presented and in the discussions which followed.

ALABAMA GEOLOGICAL SURVEY.

The field work of the geological survey during the past season has been in the gold region of Coosa, Talladega, Tallapoosa, Cleburne, Randolph and Clay Counties. Before the discovery of gold in California a great amount chiefly of placer work was done in Alabama, and many thousands of dollars' worth of gold raised. This work was almost suspended when the new fields of California were brought to notice, for the gold miners of Georgia and Alabama flocked to the new country to try their fortunes. Since 1849, the mining of gold in Alabama has been somewhat desultory, though never entirely abandoned. During the past five years there has been a renewal of interest in the industry, and many new enterprises have been set on foot. Unfortunately, however, some of these were badly managed and have come to grief, and the impression has gone abroad that the mining of gold in Alabama will not pay.

Certainly, it will not pay in the manner in which the work has been carried on at many places, for most of the plants are arranged solely for the winning of free gold and are practically useless after the mining has gone down to the drainage level, and the ore is in its original condition of a sulphuret. Thus most of the mills have ceased work after the free milling surface ore has been exhausted. A few years ago Dr. William B. Phillips undertook for the Alabama Survey an examination of the gold region of the state, but this work was interrupted by unavoidable circumstances after he had spent only a few weeks in the field. His report, in Bulletin No. 3 of the Alabama Survey documents, showed conclusively that with proper methods, such as are in use at the Hailes mine in South Carolina and elsewhere and adapted to the successful working of sulphurets, the mining of gold could be made profitable in many places within the borders of this state. The examinations of the last season have only served to confirm this opinion of Dr. Phillips and to bring to light a number of new localities where the mining of gold with proper methods of extraction may surely be made profitable The gold does not seem to be distributed over the whole of our crystalline schists, but it is mainly confined to those belts of partially crystalline, argillaceous slates which have been named the Talladega formation by the Geological Survey A part of these slates are equivalent to the Ocoee group of Dr. Safford in Tennessee. This is the belt which lies furthest towards the northwest, making the northwest border of the crystalline schists, but there are two other well defined belts of almost exactly identical rocks crossing our crystalline area further to the southeast, and these belts also are rich in gold-bearing quartz veins. In one locality only, of those examined, the gold is found in a fully crystalline mica schist.

In most instances the gold is associated with veins of quartz which appear to be interbedded with the slates themselves, and in such cases the veins are usually not solid sheets of quartz but strings of lenticular masses of quartz wrapped in the slates, and occupying a width or thickness of strata of twenty or thirty feet. In other instances the quartz veins cut across the strata and are then only a few inches in thickness but very rich in gold. In the westernmost belt of these gold bearing rocks, the quartz vein is quite thin, only a few inches, but on the other hand of exceptional richness. For several years past the attention of capitalists has been directed to the gold fields of this and adjoining states, and it appears certain that with ordinary care and good judgment in the management the mining of gold will soon be numbered among the paying industries of Alabama.

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THE CENTIMETRE GRAMME SECOND AND THE CENTIMETRE DYNE SECOND SYSTEMS OF UNITS AND A NEW GRAVITATIONAL EXPERIMENT.

BY REGINALD A. FESSENDEN, ALLEGHENY, PA.

THE C. G. S. system of units was undoubtedly a great advance over previous systems, but it has at least one serious disadvantage. This is the employment of the gramme as one of the fundamental units. Mass is not a fundamental conception, and has no claim to be put in the same class as length and time. We can conceive of matter as distinct from mass just as easily as we can conceive of matter as distinct from electricity, and far more logically, for each unit of matter is always associated with the same quantity of electricity, while the amount of mass associated with the unit of matter, *i. e.*, the atom, is more than 200 times as great in the case of some kinds of atoms as in others.

There is, therefore, this theoretical objection. There is also a practical one. Any system of units must be logical, in that the dimensional formula for any quantity must be made up of such concepts only as are necessarily associated with that quantity. This is not the case with the C. G. S. system. The dimensional formula for quantity of electricity in the electrostatic system of units is $L^{\frac{3}{2}} T^{-1} M^{\frac{1}{2}}$, in which the conception of mass is brought in. Now, mass has no connection with electricity, so far as we know at present; if there were no such thing as mass we should still have electricity, and therefore the system of units which gives such a formula is defective.

There is a second practical reason. This is, that in the C. G. S. system of units it is much more difficult to see readily relations between different quantities, and to interpret them, than in a more theoretically perfect one, on account of the fact that the M in the formula of a force which has no necessary connection with matter may cancel out with an M which has a legitimate right to be there For instance, suppose that, in working out a problem, we get such a result as M/T, this may mean almost anything, *i. e.*, it may be the product of various things, and what these are is not readily apparent.

As a matter of convenience, the writer has used a system of units in which the dyne takes the place of the gramme, and has found that there is a considerable advantage.

In this system the unit of mass drops back into its rightful place, and is a dimension of the same sort as the unit of electricity or the unit of magnetism. Gravity is treated as a separate substance, distinct from matter, but residing in it in the same way as magnetism is supposed to reside in iron, and unit quantity of gravity is defined as that quantity which will attract equal quantity placed at unit distance with unit force. The atomic weight of an atom is its permeability to gravity, and corresponds to μ in magnetism. Lines of gravitational force are supposed to radiate from a body charged with gravity in the same way as from a body charged with electricity or magnetism.

Current of gravity is the quantity of gravity which passes between any two points in unit of time, and unit of gravitational potential causes unit current of mass through unit resistance.

To show the advantage of the C. D. S. system over the C. G. S. system, the following table is subjoined, which gives the principal dimensional formulæ in Electricity, Magnetism, Heat and Gravity in both systems:

C. D. S. Units.	Gravity.	Mag.	Elec. Stat.	Elec. Mag.	Heat.
Quantity	$\sqrt{FL}$	$\sqrt{FL}$	$\sqrt{FL}$	$\sqrt{FL^2/T}$	FL
Current.	$\sqrt{FL}/T$	$\sqrt{FL}/T$	$\sqrt{FL}/T$	$\sqrt{FL^2/T^2}$	FL/T
Difference of Pot	$\sqrt{F}$	$\sqrt{F}$	$\sqrt{F}$	$\sqrt{FT/L}$	1
Resistance . .	T/L	T/L	T/L	L/T	T/FL
Capacity . . .	L	L	L	L^3/T^2	FL

C. G. S. Units.	Gravity.	Mag.	Elec. Stat.	Elec. Mag.	Heat.
Quantity .	M	$\sqrt{L^3}\sqrt{M}/T$	$\sqrt{L^3}\sqrt{M}/T$	$\sqrt{L}\sqrt{M}$	L^2M/T^2
Current . .	M/T	$\sqrt{L^3}\sqrt{M}/T^2$	$\sqrt{L^3}\sqrt{M}/T^2$	$\sqrt{L}\sqrt{M}/T$	L^2M/T^3
Difference of Pot..	L^2/T^2	$\sqrt{L}\sqrt{M}/T$	$\sqrt{L}\sqrt{M}/T$	$\sqrt{L^3}\sqrt{M}/T^2$	1
Resistance	L^2/TM	T/L	T/L	L/T	T^3L^2M
Capacity	MT^2/L^2	L	L	L^3/T^2	L^2M/T^2

Incidentally, it may be noted that the notation is more concise. This, however, is merely an accidental point, the main thing being that the C. D. S. system is "ethically" more correct, and that it does not distort ideas so much in the handling as the C. G. S. system does.

It will be found convenient to denote the different quantities by means of subscript letters. Thus, R_g, R_m, R_{es}, R_{em}, R_h represent gravitational, magnetic, electrostatic, electromagnetic, and heat resistances. So, also, W_g represents gravitational work, *i.e.*, $1/2mv^2$, W_{em} represents electrical work, or C^2R, W_h represents heat energy, being really only a particular case of W_g, in which the algebraic sum of the vectors representing the velocities is zero, and W_m represents magnetic work, or B$\times$M.M.F. One or two remarks may be made in regard to these formulæ. There has been some doubt in regard to the correct dimensional formula for temperature. This has been caused by the incorrect assumption that k, the specific heat of a body, is a number. That this is not the case follows from the law of Dulong and Petit. According to this, the atomic heat of all the elements is the same. Therefore, the heat required to raise a cubic centimetre of any substance one degree C., *i. e.*, its specific heat, is equal to the heat required to raise the temperature of a single atom the same amount $\times$ the number of atoms in the cube. This last is a number, and the former depends upon the kinetic energy of the atom. As the dimensional formula for kinetic energy is the same as that for work, *i. e.*, LF. (in the C. D. S. system), the formula for temperature must equal FL$\div$FL., *i. e.*, unity.

We obtain the same result by considering the fact that Quantity of Heat $\times$ Heat Potential must equal Work, *i. e.*, LF$\times$heat potential$=$LF. A current of Heat, then, is a current of energy, in the form of kinetic energy. Temperature is heat potential, and specific heat is heat capacity. It is evident, therefore, that, like the gramme, the calorie must vanish from a rational system of units, and its place be taken by the erg and joule. Unit heat flux is one erg per second. Unit difference of heat potential is one degree C. (Theoretically, it should be the temperature to which one erg will raise unit mass of unit matter, *i. e.*, unit mass of hydrogen.)

Unit specific heat will be possessed by a body which requires one erg to raise one cubic c. m. one degree C.

The consideration of the gravitational formulæ gives us some ideas in regard to gravity, and suggests some experiments which have as yet not been tried. The resistance of mass to motion, or inertia, varies directly as the acceleration, and as the mass. It is independent of place or the actual distance passed over in attaining the velocity. The energy possessed by a body in motion is proportioned to the integral of the various accelerations received by it, squared; *i. e.*, it varies as the velocity squared.

We have an exact analogy to this in the case of motion of matter in a frictionless fluid. Suppose a ball placed in a fluid, such as water, which we will suppose to be frictionless. Then, on moving the ball, we may conceive of a vacuum being formed behind the ball, and that this vacuum will be proportional to the square of the velocity with which we move the ball through the water. The water is, of course, supposed to have inertia, otherwise the vacuum would not form. So long as the velocity wi h which the ball is moving is constant, no work is done, and there is, therefore, no resistance to the motion, and it will continue in motion forever, unless opposed by some force. Suppose, however, that the ball meets with an obstacle which tends to stop it, then the vacuum will tend to close up, and the water will push the ball ahead, till an amount of work has thus been done equal to that done in making the vacuum originally. Such a behavior corresponds exactly with the behavior of matter moving in the ether.

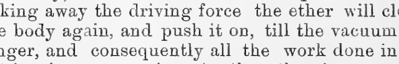
This theory, however, demands a reconception of the ether, for it is generally taken that the ether possesses no inertia. On closer examination, however, it will be seen that the difference is only apparent. In all the cases where we have had opportunity for measuring any inertia of the ether, a finite quantity only of the ether has been in motion. In the case of an electric circuit, for instance, the only ether in motion is that definite amount corresponding to the current produced. It is, of course, well known at the present time that electrical energy is not transmitted along the wire, but through the dielectric, but this does not affect the statement made that the only inertia effect which could be perceived would be that due to the motion of a definite amount of ether. Therefore, as no inertia effect has ever been found in connection with the motion of the ether in an electric circuit, we are justified in saying that the inertia of the ether is negligable in such a case. But we are not justified in saying that the inertia is negligable in the case where an infinite amount of ether is in motion, as would be the case, according to this theory, when a solid is moved through space, for an infinite amount of the infinitely small may be appreciable.

If, however, we take the two fluid theory of electricity, which, as Dr. Lodge has shown, is forced upon us by the consideration of many phenomena, and consider an electric current as the shearing past each other of two dissimilar parts, which together make up the ether, then there need be no such modification of our views, for, since in any case of electric flow there are always equal quantities of plus and minus electricity, and we may suppose the moments of inertia equal and opposite, no inertia effect could, of course, ever be observed in an electric circuit. When, however, the ether is moving as a whole, the inertia effects would be added instead of subtracted, and we would have, as shown above, all the phenomena of gravitational inertia.

It is, of course, not necessary for a body to have mass in order to display inertia effects, for its resistance to motion may be due to a "counter-motive" force, as in a circuit having self-induction; consequently there is no difficulty in accounting, in various ways, for the ether showing an inertia effect.

To take up the theory, for it is more than a mere imagining, having been worked out mathematically with some fullness in several directions; from Fizeau's experiment (confirmed by Michaelson and others), we know that when matter moves it drags with it a certain amount of the ether, but that a certain part remains behind, flowing through the matter. If this ether has any inertia (using the word in its broad sense), then there will be an effect similar to that which occurs when a sieve is moved through water. A vacuum, or a spot of less density, or of less rigidity will be formed behind the body. The size of this spot will vary as the velocity, and if the velocity is doubled the spot will be doubled, and four times as much work will be done in making it. And this no matter what the time in which the spot (which we will call the vacuum, provisionally) is formed, or where in space it is formed. On taking away the driving force the ether will close up on the body again, and push it on, till the vacuum exists no longer, and consequently all the work done in forming it is given up again. As the ether is supposed to have no friction, mere motion of the vacuum from one spot in space to another will necessitate no work, and consequently we have Newton's law, that a body tends to continue in its state, whether of moving with a given velocity, or at rest.

This is the part of the theory which deals with inertia, and the experiment referred to above is as follows: Set a body in motion, under the action of a constant force, then remove the force, and examine the body at the time when the force is removed. If the ether has inertia, then at the instant when the accelerating force is removed there will be an abnormal reduction in speed for an exceedingly small time. This will be followed by an abnormal acceleration, also acting for a very small time, and of such dimensions that after the lapse of a very small time, the velocity of the body will be the same as if neither the retardation nor the acceleration had existed. If the time during which these effects take place be not too small, it will be observable on a chronograph, and will give a trace as follows:



The dotted line shows the trace if the effect had not taken place, the other the trace if the effect does occur. It will be seen that they only differ for an exceedingly small portion of time, and it is doubtful if the experiment would succeed, even if the effect existed. It has, however, I believe, never been looked for.

If this be the true theory of inertia, then the theory of gravitation is as follows: If we take a rod of any solid substance, and press down one atom, which we will call A, it pulls down the atom next it, which we will call B, because, though the atom B is moving, it merely oscillates about a fixed point, and is always within reach of the influence of A. This property is what we call rigidity, and it is this which enables a solid to stand a shearing stress.

If the solid is melted it is called a fluid, and is commonly supposed to be unable to withstand a shearing stress. This is due to the following circumstance: Let us press down A. If B did not move, then B would have to follow A, if it were not that in a fluid the atoms no longer oscillate about a fixed point, but change their positions relatively to one another. The atom B moves at ordinary temperatures at a velocity of somewhere near 100,000 centimetres per second. The distance between any two atoms is somewhere in the neighborhood of 1/100,000,000th of a cm. Consequently in the 1/1,000,000,000,000,000th of a second, the atom B will have passed without the radius of attraction of A. Consequently we see that for any forces which are impressed in a greater time than 10^{-13} second, the fluid will have no rigidity. But if the force is applied in less time, we have no reason for supposing that the fluid will not resist shearing, or that a water tuning fork could not be constructed at the centre of the earth. For, if we accept the electrostatic theory of cohesion, the force which A exerts on B when A is pulled down travels at the rate of more than 10^{10} c. m. per second. As B will have to move say 10^{-8} c. m. to get out of the way of the pull from A, we see that if an impulse is given in less than 10^{-18}th of a second, B will be pulled down, and the fluid will resist a shear. And it is this force which acts to join the atoms together which gives rise to the phenomenon of surface tension. Consequently we see that if the ether has rigidity, whether it be a solid or a fluid, it must have surface tension.

Let us take the case of two bubbles of air in water. There is a surface tension at the junction of the air and water, and it may be shown that the effect of this is to bring the two bubbles together. A similar result would follow if the two bubbles had their places taken by two drops of water hotter than the rest of the water. Or if the drops were made up of a number of concentric shells, the density of each shell being greater than that of the shell next inside it, the equivalent of such a shell would be produced by sticking the prongs of two tuning forks into the water, for at those places where the velocity of a prong was greatest the density of the water in unit volume would be least, and the forks would be attracted. So if we suppose the atom to be, say, a Thomson vortex ring, and that this vortex ring, in virtue of its rotation, renders the ether next it less dense, or less rigid, it would attract any other atom similarly constituted in the same manner as we know two atoms do. And this attraction would be always the same in quantity, no matter what the temperature or surroundings, so long as the atom was the same, *i. e.*, its weight would be constant. And if another atom produced a different degree of density or rigidity near it, its weight would be different and constant.

Thus we see that if the ether has inertia (or some "counter motive force" opposes its motion), then matter must have inertia, and if the ether has rigidity, and atoms produce a difference in the cohesion of the ether near them, then all atoms will attract each other in proportion to the change they produce in the rigidity of the ether near them.

There are two experiments which seem at first sight to contradict Fizeau's experiment. First, the fact that a rotating disc of matter has no effect on a magnetic needle placed at its centre. Second, the fact that light suffers no retardation or acceleration when passed along the lines of force between two plates at different potentials, and placed in an electrolytic bath.

The first is readily explained when we consider that when the disc is rotating it is carrying with it ether as a whole, *i. e.*, equal quantities of positive and negative electricities, or is equivalent to two currents of equal strength flowing in opposite directions, and consequently can produce no effect outside of the body. Or, to use Prof. J. J. Thomson's symbolism, the ends of the Faraday lines are both within the body, and do not pass outside, whereas in Professor Rowland's experiment the Faraday lines have one terminal on the disc, and the other outside. The two cases are not similar.

The second case, that of the electrolytic bath. In this the ether does not move as a whole, there is merely a shearing of plus and minus electricities past each other, and the algebraic sum of the velocities of the components of the ether is therefore zero. Or, the ether does not move, so far as any possible effect on light is concerned.

THE "GLACIAL PERIOD" PROVED AS A NECESSARY CONSEQUENCE OF THE EARTH'S MOVEMENTS.

BY MAJOR GENERAL J. C. COWELL, WINDSOR CASTLE, ENGLAND.

FROM the increasing interest that is manifested in all that relates to the glacial period, and the discovery, by General Drayson, of the Second Rotation of the Earth, it will be of value to those who are studying the geological evidences of the ice ages, to devote some time to the ascertained facts proving the Second Rotation as compared with the accepted theories, since these appear to supply all the conditions necessary for the explanation of the glacial phenomena, at regular intervals; and it is with the object of rendering the subject clear to them that the following remarks are offered to the readers of *Science.*

It has hitherto been stated by Herschel and other writers of his day, that the movement of the Earth, which caused the precession of the equinoxes and solstices, and the changes in Polar distance, and Right Ascension of the Stars, is "a conical movement of the Earth's axis round the pole of the Pole of the Ecliptic as a centre."

Drayson claims that this definition is vague, if not misleading, even as regards that part which speaks of a conical movement of the axis. He claims that it is the two half axes that trace cones, the apex of these cones being at the centre of gravity of the Earth.

He also claims that this conical movement of the two half axes is the mere mechanical result of a Second Rotation of the Earth, just as the conical motion every twenty-four hours, of all lines from the Earth's centre to points at the Earth's surface, is the result of the daily rotation of the Earth.

An examination of the annual changes in Right Ascension of every Star in the Heavens (see pages 163 to 219 in "Untrodden Ground in Astronomy and Geology") proves that a second rotation is the *only* movement which will explain the recorded changes in the Right Ascension of Stars. Hence, instead of some vague and undefined movement of the Earth occurring whilst the axis has what has been called "a conical motion," the detail movements of each point on the Earth's surface are accurately defined by the second rotation. Secondly, the Earth's axis traces *a circle* round the Pole of the Ecliptic *as a centre*, keeping constantly at the same distance of 23° 28′ from it, wrote Herschel and others.

In the face of the fact that the obliquity (*i. e.*, the angular distance between these poles) decreases about 47″ per century, the above statement is obviously erroneous.

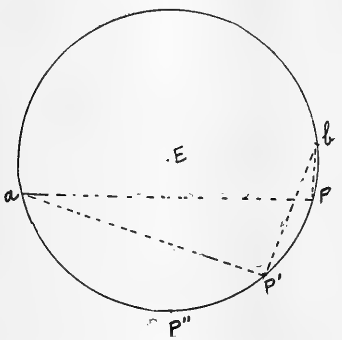
As an escape from this error it has been asserted by some that the Pole of the Heavens moves about 20″ annually at right angles to the arc joining the Pole of the Heavens with the Pole of the Ecliptic, but as the latter

Pole was supposed to move it was imagined that the course of the Pole of the Heavens was not a true circle.

Now, as it has been proved that the movement of the earth which causes the Pole of the Heavens to move, is a second rotation, it follows, as a geometrical law, that, as long as the Pole of this second rotation remains fixed, the course of the Pole of the Heavens must trace a circle, and no other curve than that of a circle. It has also been asserted that the Pole of the Heavens does trace a circle in the Heavens, but not round the Pole of the Ecliptic as a centre, this centre being *somewhere* very close to the Pole of the Ecliptic, but the exact position of this centre was unknown.

Hence, it is evident that the true curve traced by the Pole of the Heavens, or the true radius of the circle traced by the Pole of the Heavens has, during the past three hundred years, been undefined and unknown.

The confusion in one branch of astronomy which has prevailed in consequence will become evident by an examination of the following diagram:



E is the centre of the circle of which bPa is the circumference, b, P and a being three points on the circumference.

Suppose the angle bPa to be 95°. If the point P be moved to P′ then it is a geometrical law that the angle bP′a will also be 95°. Also if the point P be moved to P″ then bP″a will be 95°.

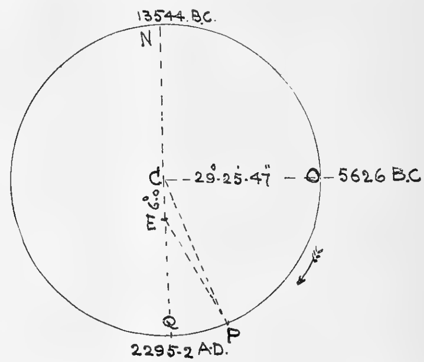
We can now apply this law to Astronomy. Suppose A and B to be two stars, and P the Pole of the Heavens, at any date, the stars being believed to be on the circumference of the circle traced by the Pole. Suppose the stars A and B to differ in Right Ascension exactly 95°. Then, as the Pole moved round the circumference to P′, the two stars A and B would always differ 95° in Right Ascension.

If repeated observations showed that the difference in Right Ascension between the stars A and B did not remain constant at 95°, but varied slightly from year to year, then these stars would be assigned *"a proper motion" in Right Ascension*, whereas the real cause of the difference in Right Ascension of these two stars, not being a constant quantity, may be due to the fact that the radius of the circle which the Pole describes is not that which it has been imagined to describe, and the two stars were not, in consequence, on the circumference of the circle. Some stars, on the other hand, are known to have a proper motion. During very many years it was asserted that the Pole of the Heavens traced a circle round the Pole of the Ecliptic *as a centre*, and on this erroneous assumption the theory of the proper motions of the stars was based. (See pages 126 to 130 in "Untrodden Ground in Astronomy and Geology.") Many earnest, hard-working men have employed their time in making out lists of the supposed proper motions of stars, and pages of astronomical societies' volumes have been filled with these lists. Medals have been given for this work, but what is their value?

To assert that any star has a "proper motion" in Right Ascension, in consequence of the Right Ascension varying, whilst the true course which the Pole of the Heavens traces has been unknown; and the exact manner in which each zenith is affected, has not even been considered yet, is very remarkable. But during the last hundred years astronomers have copied each others' proceedings, without apparently perceiving that to define the true circle traced by the Pole of the Heavens was the first important problem to be solved; and until this problem was solved any assertions relative to the proper motion of the stars were valueless.

Instead of the Pole of the Heavens tracing a circle round the Pole of the Ecliptic as a centre, and keeping constantly 23° 28′ from it, recorded observations prove that the Pole is carried by the Second Rotation round a circle, the radius of which is 29° 25′ 47″, the whole circle being completed in a period of 31,682 years, the Pole of Second Rotation being 6° from the Pole of the Ecliptic, and so situated that at the date 2295.2 A.D. the Pole of the Heavens, the Pole of the Ecliptic, and the Pole of Second Rotation will be on the same great circle of the sphere.

The following diagram indicates the course of the Pole of the Heavens during one entire Second Rotation of the earth:



The circle represents the course traced by the Pole of the Heavens, in consequence of the Second Rotation. At the date 13544 B. C. the Pole was at N, at 5626 B. C. it was at O, and at 2295.2 it will be at Q.

The distance of the Pole of the Heavens as it moves round this circle from C, the Pole of Second Rotation, is a constant quantity, viz.: 29° 25′ 47″. E, the Pole of the Ecliptic, is 6° from C. Hence, when the Pole of the Heavens was at N, it was distant from E 29° 25′ 47″ + 6° = 35° 25′ 47″.

The rate of the Second Rotation, as indicated by the length of arc over which the Pole is carried in a given time, is 40.9″ annually. Hence, we can easily calculate at what part of the circle the Pole was, or will be at, for any date. For example, at what date was the Pole at a point in the circle 90° from Q? 90° = 324000″, and these seconds divided by 40.9″ gives 7,921 years from the date 2295 A. D., that is, 5626 B. C. We now have an important triangle to deal with, viz.: the triangle ECP. We have EC = 6° (a constant) and CP = 29° 25′ 47″, another constant; when, then, we find the value of the angle

ECP (+2295–date in number of years) ×40.9″=the angle ECP at date given, we can calculate the value of the side PE, which is the distance of the Pole of the Heavens from the Pole of the Ecliptic, and is consequently the measure of the obliquity, and of the Arctic Circles, and Tropics on Earth at the date when the Pole was at P.

The method of calculating the distance PE, which is the value of the Obliquity, is very simple, and is given in detail at page 74 in "Untrodden Ground of Astronomy and Geology" (two sides and the included angle). By this calculation the Obliquity for the 1st of January, 1800, is found to be 23° 27′ 55.3″, and for the 1st January, 1850, 23° 27′ 30.9″, showing a difference of 24.4″ for fifty years during the first half of the present century. But, between 1800 and 1900, calculation gives a difference of 46.5″ (see page 75 of the same work). In Article 640 of "Outlines of Astronomy," by Herschel, is the following: "Meanwhile, there is no doubt that the plane of the Ecliptic does actually vary by the action of the Planets; the amount of this variation is about 48″ per century." This statement shows how entirely the true cause of the decrease of the obliquity was overlooked. It was positively stated that the Pole of the Heavens kept a constant distance of 23° 28′ from the Pole of the Ecliptic. If it did keep at this constant distance, then no amount of change, even of many degrees, *in the plane of the Ecliptic*, would produce even 1″ change in the obliquity, which would always remain 23° 28′.

That the Polar distance of a star can be calculated for 100 years or more, and from one observation only, is proved by numerous examples given from page 52 to 63 in "Untrodden Ground in Astronomy and Geology."

An examination of the last diagram given in this paper shows that the course of the Pole of the Heavens during one Second Rotation caused it to vary its distance from the Pole of the Ecliptic as much as 12°, and hence at the date 13544 B. C. the Arctic Circle and Tropics extended 12° more than at present, thus causing those vast changes referred to by geologists as "the Glacial Period," and giving the dates for the commencement, duration and termination of this period, which agree with the latest discoveries of geologists.

The Second Rotation gives accuracy of detail and a complete explanation of recorded facts, whilst by its aid calculations can be made which have hitherto been considered impossible. "A Conical Movement of the Earth's Axis round the Pole of the Ecleptic, as a centre, omits *all* details, and leaves recorded facts without any clear explanation. First, then, we have for a "conical movement of the earsh's axis" a second rotation of the earth, which *causes* a conical motion of the two half axes, and shows how the zenith of each locality on earth is affected by this movement. Second, for the Pole of the Heavens tracing a circle round the Pole of the Ecliptic as a centre, at a constant distance of 23° 28′, we have this centre 6° from the Pole of the Ecliptic, and 29° 25′ 47″ from the Pole of the Heavens, with the results explained above.

The following are some of the errors which have been, and still are, promulgated in consequence of the true movements of the earth being misunderstood by many persons :

First: On many celestial globes and star maps a circle is drawn round the Pole of the Ecliptic *as a centre*, and on these, near the circle, is written, "Circle described by the Pole of the Celestial Sphere in 25,868 years." This error is due to two oversights. First, although it was admitted that the two Poles decreased their distance from each other about 47″ per century at the present time, and had decreased their distance during all time of which we have any records, yet they always kept 23° 28′ apart. The second error was that, because the annual amount of the precession (about 1800 A. D.) was 50.1″, this rate was constant for all time, whereas, for a uniform movement of the Pole, the annual amount of the precession varied *with the distance apart of the two Poles.*

Second: It having been assumed by theorists that the Plane of the Ecliptic could not vary from a mean position more than 1° 21′, it has been asserted that the Obliquity could not vary more than 1° 21′. This error was promulgated in consequence of the true circle traced by the Pole of the Heavens not having been known. No matter how much *the plane* of the Ecliptic varied from a mean position, there could be no variation in the Obliquity, if the Pole of the Heavens was, as asserted, kept always 23° 28′ from the Pole of the Ecliptic.

The cause of the decrease in the Obliquity of *about* 47″ per century, its present rate, is not due to any change in the plane of the Ecliptic, but is due to the fact that the centre of the circle which the Pole describes is 6° from the Pole of the Ecliptic, instead of being coincident with it.

Third: It has been asserted that because the decrease in the Obliquity, or angular distance, between the two Poles was about 48″ per century, therefore in 10,000 years the decrease would be 4,800″=1° 20′ only.

Such a statement indicates a want of knowledge as to the *cause* of the decrease, and a forgetfulness of the geometrical law that a curve cannot decrease its distance from a point at a uniform rate.

An examination of the last diagram shows that a variation of 12° will occur in about 15000.

Fourth: It has been asserted that the Arctic Climate, which reached to about 54° Latitude during the Glacial Period cannot possibly be accounted for by astronomy. Because, "There is none amongst the slight variations of the Earth's movements which, even with the aid of any extension of time, however indefinitely great, could alter the present angle of the Earth's axis as it lies to the plane of the Earth's orbit. This angle, which is about 23°, is firmly fixed by that apparently essential property of matter—Inertia." It is singular that such a statement shou'd have been made, for the Earth's axis is not inclined to its orbit at about 23°, but at about 66° 33′, and it varies this angle at about 47″ per century at the present rate of the Earth's gyration, so it cannot be firmly fixed.

Fifth: The changes produced on various meridians and zeniths by the Second Rotation, are most important, but, notwithstanding this, have been hitherto entirely overlooked. In every observatory the Polar distance of a star is deduced from its observed meridian zenith distance, and its Right Ascension from its Meridian Transit. But, that the zeniths and meridians of two localities, differing in latitude, were differently affected by the so-called "conical motion of the axis," has been entirely disregarded.

Sixth: The standard measure of time is also affected by the Second Rotation, and a siderial day is at present a vague quantity, only imperfectly defined by the statement that it is the interval which elapses between two successive transits of the same star ; because this interval varies for nearly every star. *The only uniform standard of time* is the interval between two successive transits of the Pole of Second Rotation (see chapter 13 in "Untrodden Ground in Astronomy and Geology"). The statement made by Sir John Herschel in a foot note at the end of "Outlines of Astronomy" "that 3m. 3.68s. of purely imaginary time was inserted between 1833 and 1834 in order to correct errors, and that the whole subject of time had fallen into confusion," is the result of an incorrect standard of time having been used, and still being used.

Seventh: By the present accepted *theories*, it is not known whether the annual rate of decrease in the obliquity (which is the same thing as a decrease in the distance of the Pole of the Heavens from the Pole of the Ecliptic) has a decreasing or increasing rate. It is now, and has been during many years taken as a constant quantity of 0.476″ annually, which is geometrically as unsound, as though it were stated that the Polar distance of a star decreased each year at a uniform rate. It is not known how long this decrease in the obliquity will continue, or when it will become an increase. It has continued during 1800 years at least, but when it commenced is not known. What the obliquity was 5,000 years ago, and what it will be 5,000 years hence, is not known; because the true course traced by the Pole of the Heavens relative to the Pole of the Ecliptic has not been known.

The Second Rotation supplies all these details, and proves their accuracy, by the agreement of calculation with recorded observations. The detail movements of every zenith are given by the Second Rotation, whereas hitherto all zeniths seem to have been imagined to be similarly affected by the so-called "Conical Motion of the Earth's axis." It is impossible to conceive more convincing proof of the truth of Drayson's discovery. The Second Rotation of the Earth merely gives accuracy of detail where hitherto there has been vagueness and imperfect definition.

The various statements that have been confidently put forward regarding the impossibility of any great change having occurred in the Arctic Circles and Tropics, is due to the fact that the true course of the Pole of the Heavens relative to the Pole of the Ecliptic has hitherto been unknown. Such statements, however, having been accepted as if they were statements of fact, without full enquiry, have induced some writers to put forward extraordinary theories incapable of being proved, to account for an Arctic climate having descended to about 54° latitude within comparatively modern times.

Considering that the true course of the Pole had never been accurately defined until the Second Rotation was made known, it appears strange that so many forms of vague speculation should be seriously discussed as a possible cause of the glacial epoch, whilst the fact that the centre of the circle which the Pole describes is proved to be 6° from the Pole of the Ecliptic, has been overlooked, or considered quite impossible.

More especially is this neglect remarkable because twenty-five years ago the dates for the duration and termination of the Glacial Period were accurately given by Drayson in consequence of a knowledge of this beautiful movement, and when scarcely a geologist believed that the dates were anything but erroneous; and now what do we see? Geologists substantiating by evidences which none can doubt, the absolute accuracy of his observations and calculations.

It is to be expected, after such results, that astronomers will define, in unmistakable terms, the true course of the Pole of the Heavens relative to the Pole of the Ecliptic. The definitions of the past will not and cannot satisfy, and a consideration of the following questions ought not to be beneath the notice of any one, because until the matter is solved conclusions as to the proper motion of stars, the changes of latitude of observatories, and even the variation in eccentricity of the Earth's orbit, are assumptions only, based upon unsound foundations.

1. Is the true course of the Pole a circle round the Pole of the Ecliptic as a centre, keeping constantly at 23° 28′ from it as stated by Herschel and other writers?

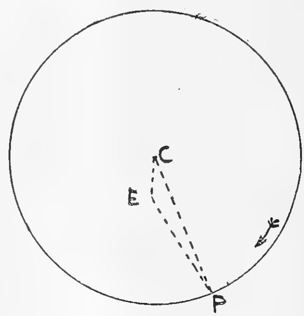
2. Is it an irregular curve always moving at right angles to the arc joining the Pole of the Heavens to a movable Pole of the Ecliptic?

3. Or, is it a circle round an undefined point, which is supposed to be the mean position of a movable Pole of the Ecliptic? If so, where is the point?

It is probable that the facts of the Second Rotation have not been carefully examined, as it appears that some individuals hold the opinion that it is merely a vague theory opposed to well established facts in astronomy. The very reverse is, however, really the case, and the following are some amongst many problems which can be solved by a knowledge of the Second Rotation of the Earth.

Such problems cannot be solved by those persons who are unacquainted with it.

Problem 1.—Calculate the mean obliquity of the Ecliptic for any date, say the 1st of January, 1873, without reference to the observed obliquity at any previous date, and without reference to the annual rate of decrease found by observation.



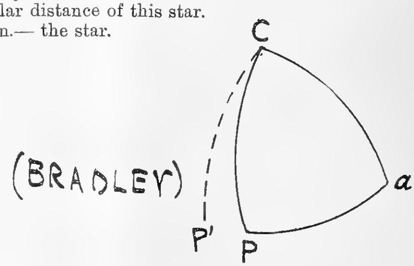
Where EC=6°-CP=29° 25′ 47″, and the angle ECP for date 1st January, 1873, is found thus:

(2295.2-1873)×40.9″=4° 47′ 47.9″ = angle ECP on the 1st January, 1873.

On calculating the value of the side PE, which is the obliquity, this value is found to be 23° 27′ 20.2″, and it is recorded in the Nautical Almanac, 1873=23° 27′ 20.88″.

Problem 2.—In Bradley's catalogue of stars for 1st January, 1755, the mean north Polar distance of Alpha Draconis was given as 24° 26′ 47.4″. This star is 26° 37′ 3″ from C, the pole of Second Rotation. Calculate the mean North Polar distance of this star for any other date, say 1st January, 1850, and 1st January, 1890, without any reference to the annual rate of variation in North Polar distance of this star.

Solution.— the star.



From a knowledge of the Second Rotation:
The side PC=29° 25′ 47″.
The side Ca=26° 37′ 3″.
From Bradley's Record Pa=24° 26′ 47.4″ on the 1st January, 1755.

Having the three sides of the spherical triangle i Ca, the angle at C can be calculated, and it proves to be 53° 15′ 26″ for the 1st January, 1755.

Owing to the Second Rotation the Pole P is carried round C as a centre, at the annual rate of 40.9″. Between 1755 and 1850 there are 95 years, which multiplied by 40.9″=1° 4′ 45 5″ for the increase of the angle at C, which becomes 54° 20′ 11.5″ for 1850, when the Pole has reached P′.

We then have P′C=29° 25′ 47″ Ca=26° 37′ 3″ and the included angle P′Ca=54° 20′ 11.5″ to calculate P′a.

By calculation P′a=24° 54′ 21.2″ and found by observation, 24° 54′ 21.4″.

For 1st January, 1890, the angle C becomes 54° 47′ 27.5″ and by calculation, as before, P′a=25° 5′ 55″, and by the Nautical Almanac 1890, 1 January=25° 5′ 54.8″.

Hence the polar distance can be calculated for 135 years to within one second; and, considering the uncertainty of refraction, it is probable that the calculation is more correct than observation.

Such a result speaks for itself, and may well excite admiration of General Drayson's perseverance during many years of tedious calculation, until his labors have at last been rewarded by the splendid discovery of the radius of the circle described by the Pole of the Heavens, and the centre of that circle.

Had Newton with his marvellous intellect known, as we do *now*, that an almost tropical climate existed in what are now Arctic regions, and an Arctic one as low as 54° of latitude; that the axis of the earth varied its inclination to the plane of the Ecliptic; and that vast elevations and depressions had occurred upon the surface of the Globe causing its centre of gravity to vary its position by the consequences of these movements, as in transferring enormous quantities of the waters of the sea from one locality to another; who can doubt that he would have discovered the manner in which the Pole of the Heavens would have moved in obedience to the law of gyration? And with such catalogues as we now possess, he might have achieved the same results as have been obtained by Drayson in discovering, as he has done, the details of the Second Rotation. At all events he would certainly have attributed the Precession of the Equinoxes to the true cause of this, and not to the assumed joint action of the sun and moon on the protuberant Equatorial Zone.

A SEGREGATION OF FRESH-WATER FISHES.

BY THEODORE GILL, M. D., PH. D., WASHINGTON, D. C.

One of the most remarkable facts in zoögeography is the segregation of the greater part of fresh-water fishes represented by the ostariophysal orders, that is, the families *Characinidae, Cyprinidae, Siluridae* and their subdivisions. These are all genetically related, and must have developed from a common stock early accommodated to the fresh water and subsequently differentiated into many families and a host of genera with many hundreds of species. The few marine representatives of that host are the *Ariinae*, or *Tachisurinae*, and the *Plotosidae*, and these must have diverged from primitive fresh-water types.

Another case of segregation of a widely distinct series of families has never been recognized, and attention should be directed to it. It is that of the haplomous fishes.

The *Haplomi* are teleocephalous fishes with a pneumatic duct and abdominal ventrals, and were considered by Prof. Cope to be an order of physostomous fishes, including *Esocidae, Umbridae, Cyprinodontidae* and *Hypsaeidae.* These are evidently related to each other, although not very closely, and are mostly fresh-water forms. There are two other families which have hitherto found no satisfactory resting place which I am disposed to associate with the typical haplomes—*Percopsidae* and *Aphredoderidae.*

If the six families thus associated are really genetically related, we would have another series of families segregated as a fresh-water group, and which must have been long established. The only one of these six families with marine representatives is *Cypronodontidae*, and this seems to be the most generalized and most nearly related to the Synentognathous fishes, on one hand, and the Perciform, on the other. Whether the salt-water Cyprinodontids are the descendents of primitive salt-water fishes or have reverted to the sea in later times, is now an open question. This I do not propose to discuss at present, reserving it for future consideration, as well as numerous collateral questions which may suggest themselves. My only object at present is to draw attention to the zoögeographical fact mentioned and the morphological problem involved.

It is noteworthy that all the families enumerated are represented in the United States, and half of them (*Hypaeidae*, or *Amblyopsidae, Percopidae* and *Aphredoderidae*) are found nowhere else. The *Esocidae* and *Umbridae* are represented in Europe as well as America. The *Cyprinodontidae*, or *Poeciliidae*, are generally distributed. All the families are remarkably well defined. Finally, it may be suggested that the unwonted position of the anus (jugular or thoracic) of two (*Amblyopsidae* and *Aphredoderidae*) is possibly more than a mere coincidence, and may be an inheritance from common ancestors.

BIOLOGICAL INVESTIGATION IN BOTANY.

BY J. CHRISTIAN BAY, BACTERIOLOGIST OF THE IOWA STATE BOARD OF HEALTH, AMES, IOWA.

A couple of smaller notes on the biological question, as far as botany is concerned, were published by me in this journal. To the first of these, What is biology? this little note is to be regarded as an appendix. My first paper contained, originally, a number of notes on the modern methods of biological investigation in botany; I kept them back in order that they should not be misunderstood.

A short time ago I received Professor N. Wille's inauguration speech in taking the chair of botany at Christiania, Norway. Professor Wille has said, in a few words, what I wished to say on the occasion above referred to. Therefore, I shall quote him:

"The so-called plant-biology is a child of the Darwinian theory of selection. It should be called, more correctly, *oecology.* This branch of investigation should embrace, as nearly as possible, the science of all life-phenomena of plants, *minus* physiology: in other words, oecology is the science of the mutual relationship between the plant and the surrounding nature, when this relationship does not rest upon physical and chemical causes.

"Oecology has still retained many reminiscences from the teleological conception of earlier days, when nature as a whole was thought of as created for the sake of being principally of use to, or a plaything for, the human race. Plant oecologists, or as they like to call themselves, plant biologists, have the idea that everything must be useful or developed in a certain way in order to be of use for certain purposes.

"We shall give an example of one of the typical representatives of this line of study. He placed an ant on the leaf of *Sonchus*, and found that the ant tore the cuticula, so that the milk juice from the leaf came out. The resin of this juice stuck to the ant, which became so affected by it that it rolled down from the leaf. The conclusion drawn from this experiment was that milk juice is, wherever it is found, protective against ants, and keeps them away from the plants.

"It is easily understood that it is unallowable to draw such general conclusions from facts so uncertain and which prove so little. Before such a conclusion could be drawn, we ought to find answers to the following questions:

"1. Are the ants kept away from the plant by the milk juice?

"2. How much damage would the ants make, and how would they eventually make it?

"3. Is this damage so extensive that it would be in proportion to the energy used in producing the milk juice?

"4. Is the milk juice produced for a certain purpose, or is it only an inevitable by-product of metabolism?

"5. Does the milk juice of Sonchus serve for other purposes?

"6. Is the milk juice not serving for different purposes in the different plants?

"To give an answer to these questions would take years of study; therefore, it is easier to draw conclusions from the observations made in a few minutes, by means of imagination. The importance of imagination to the investigator is not to be underestimated, but critical consideration must separate out the chaff. However, it occurs to me that he who looks round, at present, in the science of plant biology, will find more chaff than grains."

This is another reason why biology should not replace physiology. It is pleasing to know that excellent biological theories have been established by Darwin, Bütschli, Schimper, Schwendener, Haberlandt, Mueller, Moeller, Lundström, Warming, Delpino and many others, and the most important facts put on record by such men as Trelease, Robertson, and many Europeans; but outside of flower-biology a great deal of the work done—especially when the facts have been arranged in order to prove a theory made beforehand—cannot stand close inspection.

LETTERS TO THE EDITOR.

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

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

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

The Imaginary Race of Canstadt or Neanderthal.

Dr. D. G. Brinton, in his "Current Notes on Anthropology"—XXII (*Science*, Feb. 10, 1893), has given a brief summary of what has been said about the skulls of Canstadt and Neanderthal at the twenty-third meeting of the German Anthropological Association at Ulm (August, 1892). According to this summary, many facts allied by von Holder, Virchow, Kollman and Fraas, show that the skull of Canstadt, in all probability, belongs to the fourth or fifth century, A.D., and that the Neanderthal skull is hardly more ancient. In short, the human race of the quaternary period, described by de Quatrefages and Hamy, has never existed,—it is an "imaginary race," and "it should be recognized, once for all, that there is no sort of foundation for these scientific dreams."

Mr. Henry W. Haynes has answered to two points of Dr. Brinton's article (*Science*, Feb. 24, 1893). This answer was followed by Dr. Brinton's reply (*Science*, March 10, 1893). Finally, Mr. E. W. Claypole (*Science*, April 7, 1893) has sent a short note in answer to Dr. Brinton.

In their answers, Mr. Henry W. Haynes and Mr. E. W. Claypole have discussed the historical aspect of the question, but the main point has not been handled. This will be my aim.

According to the explanations given in 1867, 1872 and 1892, by Dr. von Holder, Dr. Fraas of Stuttgard, and Virchow, it is stated that the Canstadt skull has no date.

Be it so, I do not object.

According to the statements of the same German anthropologists, Dr. Fullroth's relation concerning the skulls of Neanderthal discovery is false, and it is by no means demonstrated that this celebrated skull is a fossil one, but, on the contrary, it has probably belonged to a Frank.

Be it so, if you like; I can agree with it.

But I cannot agree with Dr. von Holder concluding: "Die Rasse von Canstadt ist also meiner Ansicht nach ein Phantasiegebilde wenn ich so sagen darf, in vielleicht eben so hohen Maasse wie die schönen Gedanken es sind, die über den Neanderthaler Fund in die Oeffentlichkeit gedrungen sind"—and I must protest against Dr. Fraas's like conclusions: "Wir dürfen füglich die Cannstatter Rasse für immer zur Ruhe legen, und hoffen dass sie nicht mehr auferstehe, die Geister zu beunruhigen."

I may forsake to the anthropologists of the Congress at Ulm the skull of Canstadt, and, perhaps, the skull of Neanderthal; but the fossil human race of Europe—which we are speaking about—has not been established *over those two documents only.* There are, further, the fossil bones or skulls of Staegenaes (Sweden); of La Denise (France); of L'Olmo (Italy); of Eguisheim (Germany); of Clichy (France); of Brüx (Bohemia); of Schipka (Moravia); of Tilbury docks (London); of Arcy (France); of Gourdan (France); of Malarmand (France); of Goyet (Belgium); of La Naulette (Belgium); of Spy (Belgium).

The Congress of Ulm has forgotten all those, and discussed the skulls of Canstadt and Neanderthal only, *as if the fossil race of our ancient European ancestors were personified in these two skulls.*

People certainly know that de Quatrefages and Hamy have given to every one of the pre-historic races they established a name recalling the most ancient or the most celebrated locality where were found human remains reported to one of those types. The names "race of Canstadt," "race of Cro-Magnon," "race of Furfooz," have no other meaning for those anthropologists, and must not have any other signification for ourselves

Logically, therefore, M. Virchow, von Holder and Fraas could only conclude "that de Quatrefages and Hamy had been unlucky by choosing precisely Neanderthal and Canstadt in order to christen that race." They could affirm nothing more.

Before being empowered to conclude that there is no fossil human race presenting the type of the Canstadt's or Neanderthal's skull, they ought to have examined every other discovery and demonstrated that those discoveries were of no more value than the one of Canstadt or Neanderthal. Then only they could rightly call that race a "Phantasiegebilde." But they did not.

I do not wish to examine by myself every one of the discoveries I have quoted, and to discuss their value. I will only examine the human remains of Spy—having been an actor by their discovery and author of their description. For seven years I have been now busy with the study of these remains.

One of the discoverers, Professor Max Lohest, will show in a forthcoming issue of *Science* the geological value of the human remains found at Spy; and I myself will endeavor, in my following letters, to show the anthropological signification of those remains.

American readers will then be able to decide if this ancient race, established by de Quatrefages and Hamy, is an "imaginary" one and a "Phantasiegebilde" or not.

Julien Fraipont.

Liege, Belgium, Dec. 1, 1893.

Molothrus Ater and His Hostesses.

Noticing the article by Charles W. Hargitt, Ph. D., in *Science* for Dec. 1, in regard to the cowbird, I am prompted to relate my experience, since what seems to be with him a rare occurrence, is, in my locality at least, a very common one. I refer to the appropriation of the chipping sparrow's nest by this parasite as a receptacle for its eggs.

It has been my experience with the chipping sparrow, as it has Mr. Hargitt's, that it is exceedingly sensitive about having its nest disturbed, and will desert it upon the least provocation, even though the full complement of eggs may have been deposited. It has seemed to me sometimes that merely a sudden discovery of the nest, with the bird upon it, was all the ground the bird needed as a cause for a hasty removal from those parts, even though not a twig or portion of the tree or bush be touched. This I have particularly noticed, and as I have been making this species a special study the past Summer, I have had occasion to note many times the exceeding sensitiveness of the bird in this regard.

But much as *Spizella socialis* dislikes to have her nest disturbed, my observations have been to the effect that her likes and dislikes are not at all regarded by the cowbird. The evidence which my observations have produced along this line is quite to the contrary of that which Mr. Hargitt's observations find. I well remember that the first egg of the cowbird ever found by myself, in those days of fond recollections when I first began the delightful pursuit now so dear to me, rested snugly in a nest of the chipping sparrow. Since that time I have never dreamed of this being a rare occurrence, for I have so found them times without number ; and in several instances have known the hostess so imposed upon, contrary to her exceeding wariness of being disturbed, to accept the situation forced upon her and rear the alien vagabond. I have also found that, in cases where the cowbird found *Spizella's* nest to contain but one egg of its owner, it will sometimes deposit more than one of its own; in one case, I found three. In such instances, the chipping sparrow, of course, does not accept the situation,—the *sit*-uation is doubtless too large for such a small bird to accept. I can only say in conclusion of this part of my subject that my observations lead me in quite the opposite direction from Mr. Hargitt's conclusion, for I certainly have found *Spizella socialis* a very commonly imposed-upon hostess of the cowbird.

I have at different times found eggs of *Molothrus* in what seemed to me to be out-of-the-way places for them. Among these "out-of-the-way places" I would mention the nests of the meadowlark, robin and kingbird, for I have found them there, and apparently no attempts had been made to remove them from the nest, for in the cases of the meadowlark and kingbird they were equally advanced in incubation with the rightful occupants.

And now, if I may be pardoned for deviating somewhat from my subject, and since the chipping sparrow's sensitive nature is before us for consideration, I would like to ask for enlightenment from more experienced heads than mine in regard to a matter that has puzzled me. The past summer I found a nest of the chipping sparrow containing four eggs. Meaning to test the bird's sensitive nature in this case, I did not so much as touch any portion of the evergreen tree containing the nest, but hastily removed from the locality. Returning two days later to learn if, perchance, the bird had deigned to still occupy her well-hidden home, I found that in place of the four eggs only two remained. Returning again the next day, I found but one egg in the nest, and coming again the following day, I found an empty nest. The eggs must have been removed from the nest without being broken, for not a trace of an egg-shell was anywhere about.

This in and of itself would not necessarily be a very remarkable occurrence, but this is only one instance. I have several times observed the same things in cases where a nest of the chipping sparrow had been discovered containing eggs.

Can the editor of *Science* or any of its readers offer a solution of this problem? I should be interested to hear.

The chipping sparrow is well worthy the study of everyone. Many excellent traits of character will be discovered. Neil F. Posson.

Batavia, N. Y.

Protection of Birds from the Boys.

In *Science*, Nov. 10, Dr. Shufeldt charges the "small boys" with being the most destructive of all the agencies that are operating to exterminate our beautiful and useful birds. Teachers in urban schools who conscientiously study the daily conduct of their pupils and inquire of them as to their daily associations know that the Doctor's statements are sadly near the truth. The accusation would better be made without limitation in the size of the boys. In every city and town, and in many villages, there is a considerable population living in homes entirely destitute of humanizing influences. The children of this class run at large, exercising their brutal and vicious instincts, and the unlimited slaughter of innocent birds is one of the results.

The evil being defined and located, the remedy is indicated. We look to the public schools for the redemption of Young America. The rapidly broadening scope which is being permitted in the work of the schools opens the way for a campaign of education.

Several lines of attack will at once suggest themselves to teachers and others who are interested. Some of these I will mention.

1. *Punishment of the guilty under such laws as exist for the protection of birds.* No teacher is likely to use this means except in extreme cases.

2. *Teaching beautiful sentiments about birds and bird life.* This is good so far as it goes. Kindly feelings are aroused and strengthened. But many hardened ones refuse to be touched and seize the first opportunity to show their defiance in a practical manner. At the best this course gives little real knowledge of the birds and the children remain strangers to them while they should have most intimate daily acquaintance. The proper place for such teaching is supplemental to the following.

3. *Close, accurate, continued study of birds, their ways, and their works.* By this procedure the work is given an intellectual basis. This method rests on a sound psychological principle. Any student of birds who can recall the impressions of his early studies knows that every new perception of beauty and adaptation in the structures of his specimens increased his regard for the living forms and restrained him from needless destruction of their lives even for legitimate purposes of study. The same key will open the way to the feelings of most boys. The glittering plumage in the bush excites the savage instinct to possess it. This interest is only momentary, and when the coveted object has been brought down by stone or shot it is soon flung aside. It would be a hundred times better if the boy shot birds to study them, but that is not necessary. Plenty of material may be collected without intentionally taking the life of a single bird, and we may hope to

make the bodies of birds objects of sacred regard to most boys so that they shall not wish to deprive them of life.

In every city a considerable number of birds meet accidental death every year, especially during the seasons of migrations. Many of these are picked up by the children while fresh and fit to handle. These unfortunate birds will become the source of most of our material. In any corps of teachers we would expect to find at least one with sufficient knowledge of taxidermy to prepare the skins suitably for preservation and study. Some of the older boys will gladly learn to do this work, and a few will become quite efficient, so that the labor will not only be taken off the hands of the teacher but will become of educational value to the pupils.

The deserted nests should be freely taken for study. After studying, in winter, the nests of last season, most pupils will be early on watch to see the new nests built. This will lead them to observe the more touching actions of the birds. At all times the teacher should be on the watch for opportunities to make direct appeal to the moral nature, but it should be done unobtrusively.

4. *Organize pupils into bird-protecting societies.* By this means unite all pupils, who are sufficiently awakened, in an effort to protect the birds and their nests, to provide nesting places for those species that come near human habitations, and to exert a restraining and educating influence on the thoughtless and vicious. By this means the few children who never enter the public schools could be watched and possibly influenced.

In an attempt to carry out the plan outlined above some difficulties and dangers must be met. Considerable knowledge of birds is necessary to the one who directs the undertaking. Details of method in the school room would occupy pages and would not be in place here. It is sufficient for the present to state that the writer knows where this plan is being tried with encouraging progress. C. D. McLouth.

Muskegon, Mich., Dec. 16, 1893.

Bird Notes.

The notes published in a recent issue of *Science* on "Birds Which Sing on the Nest" recalls an interesting instance of this kind that came to my notice last summer. It shows that the black-billed cuckoo is not always as quiet and retiring as we generally consider him. A pair of these birds built their nest in my friend's door-yard, so close to the house that it afforded a good opportunity to observe them. This pair were unusually loquacious, and throughout the period of incubation the bird on the nest was often heard holding a conversation with its mate lurking in the trees about the premises. When one bird flew to its perch on a certain tree, preparatory to flying to the nest, there was likely to be considerable chatter before it approached nearer. It is interesting to note that while some birds are quiet when incubating, as if to escape observation, their young often make considerable noise while yet in the nest. The flicker is a case in point. To merely hammer on the tree in which the nest is located is often enough to set the whole family going. I have also heard young bluebirds calling *"we-a-ry"* from their nest in a hollow stub. And, as for the young crow, his *"gobble, gobble, gobble,"* when being fed, is a well-known sound in the woods in spring, and often betrays the nest to the young bird's-nester. Willard N. Clute.

Binghamton, N. Y., Dec. 13, 1893.

Postage on Natural History Specimens.

In your issue of Nov. 17, with reference to a ruling that natural history specimens cannot be transmitted through the mails as "samples" it is suggested that the various scientific bodies of the United States should use their influence to induce the governments of certain enumerated countries to consent to such material passing by sample post. It is sought to throw the blame upon the countries in question, whereas the trouble arises solely from the fact that the United States have not yet advanced far enough to have a *parcel post* as is in operation among these other countries. There is no difficulty in transmitting specimens from Canada to the most remote countries, but the United States by their policy make it impossible to receive or to send them. The scientific societies should exert their influence at home, and endeavor to have the United States Congress adopt the more advanced and liberal postal arrangements of the countries which your correspondents blame for their troubles.

W. HAGUE HARRINGTON.

Ottawa, Canada, Dec. 14, 1893.

A DICTIONARY OF SCIENTIFIC TERMS.

IN answer to the query of B. S. Bowdish regarding a pronouncing dictionary of scientific names I would mention "A Manual of Scientific Terms," by Stormouth. Edinburgh, James Thin; London, Simpkin Marshall & Co. 1892. This is a small handy book of xi + 488 pp., giving the pronunciation, derivation and definition of the terms used in botany, natural history, anatomy, medicine, etc., and contains an excellent appendix giving alphabetical lists of specific names, prefixes and postfixes with their definitions. I would consider it just the book for the purpose mentioned in the query.

WALTER C. KERR.

New Brighton, Staten Island, Dec. 12, 1893.

NOTES AND NEWS.

FIRE destroyed the contents of the stock room of the Salisbury Laboratory, Worcester Polytechnic Institute, Worcester, Mass., on the morning of Dec. 2. The new stock for the work of the current year had just been received, and much of it had been imported from Germany with no little pains by Dr. L. P. Kinnicutt and his assistants. The loss on the stock and apparatus amounts to $3,000, and the building was damaged to the extent of $1,500. There was ample insurance. Had it not been for the substantial character of the building, which is of brick, with brick partitions and wire-lath ceilings, the firemen would have been unable to save the structure. The stock room was in the fourth story. The Freshman laboratory adjoining was injured by smoke, and the chemical library below the stock room was damaged somewhat by water. It is believed that the fire was caused by an overheated chimney.

—The Board of Education of the city of Saginaw, Mich., has provided for a museum in connection with its East Side High School. This is now well under way and is to include departments of archæology, ethnology, ostiology, physiology, botany, zoölogy, chemistry, geology, history and economic industries. Part of the museum is to build up itself naturally by small accessions. Specimens will be transferred to this section only as they are illustrative of the branches in which instruction is given. In this way it is hoped the section may be developed, by the students themselves, into a typical High School museum entirely independent of the remaining specimens, which will be arranged more as a public museum, with attention to original research in the lines being investigated by citizens. An endeavor will be made that this museum shall *not* become a mere place for the storing of curiosities, but may be built up each step with a purpose into a teaching institution.

—The Iowa Academy of Sciences will meet in Des Moines, Iowa, Dec. 26 and 27, 1893. This Academy includes the active scientific workers of the state and a very interesting programme is prepared, including papers on the geology and natural history of the state, as well as papers in chemistry, physics and engineering. The meetings will be held in the Y. M. C. A. building, and all who are interested in the objects of the Academy are cordially invited to attend the sessions and take part in the discussions. The programmes may be obtained prior to the meeting by addressing the Secretary, Herbert Osborn, Ames, Iowa.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Museum of Hamline University desires to exchange Marine Shells, preserved alcoholic material of marine zoology, or microscopic slides for zoological specimens from southern and western United States, especially for rodents in the flesh. Correspondence solicited. Address Henry L. Osborn, Biological Laboratory of Hamline University, St. Paul, Minnesota.

For Sale.—Small collection of fine first-class sets of birds' eggs; single breech-loading shotgun, gold-filled hunting-case watch and telescope. Write for list of eggs and particulars. B. S. Bowdish, Phelps, N. Y.

I am desirous of obtaining the following back numbers of *The Auk*: One copy each of Oct., 1885; July, 1886; January, 1887; July, 1887; April and July, 1891 and two copies each of the following: January, 1886 Oct. 1886; Oct., 1887; July, 1888; January, 1889; January, 1890. My own contributions in them only are required; otherwise the copies need not be perfect. I have in exchange for them two vols. (zoology) Mex. Bound'y Surveys (col. plates) or complete set of English reprints of "Osteology of Arctic Water-Birds, etc." (9 parts, 24 lith. plates); or other rare scientific reprints of any subject required. Address Dr. Shufeldt, Takoma, D. C.

For Sale.—The first eleven volumes of Crooke's Quarterly Journal of Science, 7 vols. 1st series, 4 vols. 2nd series, beautifully bound, half morocco, as good as new, for $30. John J. Jarmey, 93 Indianola Place, Columbus, Ohio.

For Sale.—A very fine telescope, length extended, twenty-five inches, closed, seven inches. Power twenty-five times. Good as new. Cost $25.00. Will sell for the best cash offer. B. S. Bowdish, Box 165, Phelps, N. Y.

Wants.

WANTED to exchange for human bones or recent medical text-books, the following books: "Metallurgy of Silver," M. Eissler, 1889; "Practical Treatise on Petroleum," by Benj. J. Crewe, 1887; "Cook's Chemical Philosophy," 1885; "Cairn's Chemical Analysis," 1880; "Wagner's Chemical Technology," by Crookes, 1886; "Fresemier's Qual. Chem. Analysis," 1879; "Elementary Treatise on Practical Chemistry and Qual. Analysis."—Clowes, 1881; bound Vols. 1 to 12 of Dr. Lardner's "Museum of Science and Art" (very rare), 1854; back numbers of "Electrical World," beautiful specimens of Pyrite Incrustations from Cretaceous of New Jersey; Magnetis Iron Ore, Highly Polarized. Address D. T. Marshall, Metuchen, N. J.

WANTED.—Books or information on the microscopical determination of blood and hair. Also reports of cases where hair has played an important part in the identification of an individual. Address Maurice Reiker, 206 N. First Ave., Marshalltwn, Iowa.

A GEOLOGIST thoroughly conversant with the geology of the Southern States desires an engagement. Has complete knowledge of the economic geology of Iron, Coal, Lignite, as well as Clay and Kaolin. Five years' experience with Geological Surveys. Address K., 509 West Sixth Street, Austin, Texas.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

WANTED.—Icones Muscorum by W. D. Sullivant, with or without Supplement, but both preferred. Address, stating price and condition of books, Dr. G. N. Best, Rosemont, N. J.

SCIENCE

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SCIENCE

NEW YORK, DECEMBER 29, 1893.

FROST PLANTS: A RESUME.

BY D. T. MACDOUGAL, UNIVERSITY OF MINNESOTA.

PROF. LESTER F. WARD'S observations on the "Frost Freaks of the Dittany," in the *Botanical Gazette* for April, 1893, obtain more than a passing interest, since the phenomenon recorded—ever but little noticed, and recently almost forgotten—illustrates one form of the action of the woody tissues, and the medullary rays, in the movements of water in the plant stem.

Since the article mentioned and the accompanying cut may not be accessible to all of the readers of *Science*, it may be pertinent to say that the frost phenomena of this and other plants consist principally of the formation of very thin sheets of crystals of ice on the sides of the stem near the ground. These crystals are attached only by one edge, and extend their length of several inches out into the air in a sinuous or scroll-like form. The interpretation of the facts affording this phenomenon seems to the author to be of such importance as to justify their presentation here.

The first observation recorded is that of Stephen Elliot, who "notices a remarkable protrusion of icy crystals from the stems *Couyza bifrons*" (now *Pluchea bifrons*). (1824. Sketch of the Botany of South Carolina and Georgia, Vol. 2, p. 322.)

Sir John F. Herschel notices a similar occurrence on the stalks of the thistle and heliotrope, in the *London and Edinburgh Philos phical Magazine* (1833. 3d series, Vol. 2, p. 110).

Prof. S. R. Rigaud notices the analogous formation of ice crystals on a newly-built stone wall, in the same journal (l. c. p. 190).

The frost freaks of the dittany were first noticed by Dr. Darlington in his "Flora Cestrica" (1837. p. 350). In his description of the *Cunila Mariana* (the dittany) he says: "In the beginning of winter, after a rain, very curious and fantastic ribands of ice may often be observed attached to the base of the stems of this plant, produced, I presume, by the moisture from the earth rising by capillary attraction, and then being gradually forced out horizontally through a slit by the process of freezing The same phenomenon has been noticed in other plants." Referring to Helianthemum Canadense, he says: "Prof. Eaton and Dr. Bigelow have noticed the formation, in freezing weather, of curiously curved ice crystals near the root of H. Canadense" (l. c. p. 314).

Prof. John Leconte made a study of the frost phenomena of *Pluchea bifrons* and *P. camphorata Decand.*, in November and December, 1848, along the coast of South Carolina and Georgia. The results of his observations, and a consideration of the results of some of the preceding workers, are given in the Proceedings of the A. A. A. S. for 1850, under the title of "Observations on a Remarkable Exudation of Ice from the Stems of Vegetables, and a Singular Protrusion of Icy Columns from Certain Kinds of Earth During Frosty Weather."

The frost phenomena noted by these several observers on the various plants agree in their general features, and it is only necessary to present the conclusions reached by Leconte in his lengthy and detailed consideration of the subject. The points which appear to be well established are:

1. The ice crystals on any plant are in the form of sheets, one to five in number, about three or four inches in width, and extending one to five inches from the plant.
2. The crystals are attached in longitudinal lines, following the medullary rays, in the portion of the stem immediately above the ground, around which they are arranged symmetrically or unsymmetrically.
3. The crystals appear to have their origin at the outer surface of the fibro-vascular ring, and protrude through slits in the bark, which has been ruptured in their formation. If the bark is strong enough to resist this rupture, the ice extends around the plant in the form of a thin layer of ice between the wood and bark.
4. When the crystals did not extend into the woody ring, they might appear in the same position several days in succession: if, however, the crystals extended through the wood along the rays, the wood split apart in the freezing, and no more crystals could be formed at that place.
5. The stems had ceased growing and were in all stages, from almost green to entirely dead; in all cases the stems were more or less saturated with water. The phenomena is entirely physical: similar formations are exhibited by certain soils.
6. The crystals are formed in the greatest profusion immediately after rainfall, and at a temperature slightly below 30° F.

All of these conclusions are fully warranted by the facts recorded, but when Professor Leconte sought an explanation of the actual movement of water in the plant stem necessary for the formation of the crystals, he was, of course, limited by the somewhat crude knowledge of plant anatomy current at that time. His reasoning that plants to show frost phenomena must be annual and herbaceous is entirely at fault, since the very plants upon which he worked are described by many botanists as biennials, as well as Helianthemum, on which the phenomenon is most frequently noticed. Again, while herbaceous stems doubtless furnish these crystals in greater profusion, the stem of Helianthemum is very woody and hard, with a relatively small section of pith. He reasons that the water "is drawn upward through the highly porous pith, while the wedge-shaped medullary rays secure the mechanical conditions necessary for the projectile force in the proper direction."

Of course, the water is drawn upward through the vessels near the pith, and is conducted laterally by the medullary rays. That the fluid does take this course in the dead stems was proven by the author, by allowing them to absorb and carry up colored solutions. It appears that the water is taken up by the simple saturation of the roots from the charged soil, without the intervention of the special activity of the root hairs, as is shown by the fact that plants dug up and replanted, which would destroy the larger number of the root hairs, still formed crystals as usual. Then root pressure must be entirely wanting, as well as osmotic activity in plants at this stage. Neither can the elevation of the water be due to "negative pressure," since the portion of the stem above the crystal-forming part may be split, or broken, or cut entirely away, without affecting the formation of the crystals.

Capillary force is the only means by which the water may be carried from the ground up through the plant to where it forms crystals. The constant absorption and evaporation by the dessicating tissues limit the region of saturation and confine the formation of crystals to the basal portion of the stems. The size and arrangement of the medullary cells favor the lateral conduction of the water by reason of their greater capillary power. The portion of water at the peripheral ends of the rays is frozen and in expanding is forced outward. The portions which replace it are in turn frozen, and the successive increments thus formed give the length and account for the perpendicular striations of the ice riband. This is suggested by Professor Leconte, though he compares the whole ray with the capillary pores of the soil in its action. A temperature of several degrees below freezing point is necessary to overcome the capillary force, and freeze the water in the rays, which results in the splitting of the stem.

So far as can be learned from an examination of the stems of the "frost plants," the only structural conditions necessary are large and numerous vessels, thin-walled medullary cells in a well marked ray, and a bark easily split longitudinally. The category of plants furnishing these conditions is by no means small. And it seems highly probable that frost phenomena may be exhibited by any of these plants which may pass through the death stage at the season affording the necessary conditions of temperature and moisture.

I am indebted to Prof. Lester F. Ward for some of the references given above, as well as for other helpful suggestions.

QUANTITATIVE COMPARISONS: A COMMON ERROR OF LANGUAGE.

BY GEORGE H. JOHNSON, SC. D., ST. LOUIS, MO.

In expressing the degrees in which any object—using the word in its broadest or metaphysical sense—possesses a certain attribute or characteristic there must be understood a unit of comparison or measurement. To be comprehensible, this unit must be subject to the associative law of mathematics; that is to say, if subtracted from itself the remainder must be nothing, or the zero of the scale of comparision, if added to itself the sum must be twice itself, and if from the unit—supposed positive—there be subtracted a quantity greater than itself, the remainder must be negative. These facts, which seem so axiomatic as to make their statement superfluous, are frequently overlooked even by some eminent speakers and writers.

If we say that A is twice as long as B, we make B the unit of comparison and affirm that the length of B is contained twice in that of A, or, no length being the zero of linear measurement, the length of B is one unit and that of A is two units. Similarly, if we say that A is three-halves longer than B we have:

$$\text{Length A} = \text{length B} + 3/2 \text{ length B} = 5/2 \text{ length B};$$

and if A is three-halves shorter than B we have:

$$\text{Length A} = \text{length B} - 3/2 \text{ length B} = -1/2 \text{ length B}.$$

Now such a negative can occur only as indicative of reversed direction or position relative to the zero, and when no direction or position is assumed as positive the negative, as well as its imaginary roots, expresses the impossible. For example, when we say it is twice as far from A to B as from A to C, we have no reference to the positions or directions of the lines A B and A C, but only to their relative lengths, and a negative expression under these conditions is impossible in any system of mathematics.

A photographer advertised that by an improved process he could take pictures thirty times quicker than by the old process. Here, if T is the time required by the old process and T′ the time required by the new process, we have:

$$T' = T - 30\,T = -29\,T;$$

the negative T being the algebraic expression for "less than no time." Granting the claim of the advertisement, it necessarilly follows that the passage of time could be stopped or reversed at our pleasure and the rapidity of its backward flight would be determined only by the number of photographs taken by the new process in a unit of time. Amateur photographers will doubtless be pleased to know that they have the fountain of eternal youth so easily within their reach! It is true, however, that if an arbitrary assumption be made in regard to the zero of the scale of "quickness" the claim of the advertisement may be verified. For example, if we agree to take one second, s, as the zero of measurements, all increments constituting slowness and all decrements quickness, Q, then if $T = 59/60$ s we have $Q = 1/60$ s and $Q' = 30/60$ s, whence

$$T' = T - Q' = 29/60\,\text{s};$$

so that the time by the new process would be nearly half the time by the old process. But the "thirty times quicker" was doubtless intended to mean one-thirtieth of the time, and so was a notable example of an unsuccessful and absurd attempt to make a quantitative statement.

A more remarkable example, because it occurred in a carefully written essay by an eminent scientist describing a variable star, is as follows:

"On April 27 it had become invisible in the great telescope. It was then one hundred and sixty thousand times fainter than it was at the time of discovery."

Now it is evident what would be meant by saying that it was one hundred and sixty thousand times brighter at one time than another, because brightness is an essentially positive quality whose quantity is dependent upon if not proportional to the amount of luminous energy eminating from the body; but faintness is a negative quality expressing only the absence of brightness; hence if there was no lack of brightness in the star when discovered, faintness at any other time could not be expressed comparatively by using any positive factor however large.

Considering the quotation grammatically the star is said to be "fainter" in the comparative degree; hence it is evident that it was first faint in the positive degree, and since no unit of faintness is used in photometry we can only assume that the brightness of the star in its positive condition of faintness as observed at discovery is the unit of comparison; hence when it was one hundred and sixty thousand times fainter it must have been (160,000–1) times less bright than an invisible body—since the latter, without luminous energy, has no brightness and presumably one unit of faintness.

After the author of the statement quoted has shown that 160,000 times fainter is equivalent to 1/160,000 as bright, which is doubtless what he meant, I will show that a liability of $1.00 is the same thing as assets of $159,999.00; and such a blessed discovery for insolvent debtors and their creditors would have so many degrees of brightness as to quite outshine any variable star!

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VARIATION IN SPORES OF CORN SMUT.

BY A. S. HITCHCOCK, MANHATTAN, KAS.

A DIAGNOSTIC character among cryptogamic plants is the size of the spores. Since the size varies it has been customary in descriptive works to give the spore measurements between the limits of observed variation. These limits show the actual variation, or nearly so, only when a large number of observations are made. It is well known that in many cases of original descriptions the measurements are founded upon too small a number of spores. But suppose the limit of variation is known, it is still desirable to know the usual size. There are only a few individuals that approach either extreme, and the greater number will lie near the average.

A curve might be constructed to show the variation of a given species by laying off abscissas representing equal differences in a given dimension and erecting ordinates whose lengths shall represent the number of spores having the corresponding dimension. If this curve descends rapidly from the maximum and afterwards gradually approaches the axis, it becomes more necessary to know the usual limits than the extremes, since spores lying near the extremes are proportionately more infrequent than where the curve approaches the axis of X more abruptly. The curve will probably always show two points of inflexion, and these two points will represent the usual limits.

In testing the matter by applying it to the measurement of corn smut spores I arrived at a somewhat unexpected result. Spores from several different sources were thoroughly mixed and samples from various parts of the mixture mounted in water. In taking the measurements, all the spores passing within convenient range of the micrometer were measured until about fifty observations were made. The results are in divisions of the eye-piece micrometer, each of which represents 3.85 μ. The 500 spores measured may be arranged as follows:

Diameter....	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1
Number.....	3	2	18	67	92	89	66	41	38	28	21	20	10	4	1

Since it is rather difficult to estimate correctly 1/10 of a division on the micrometer, it will be well to unite the results in pairs. We shall then have:

Divisions	1.7	1.9	2.1	2 3	2.5	2.7	2.9	3.1
Number	5	85	181	107	66	41	14	1

If the curve is constructed for this set of measurements, we find that it is not symmetrical around the axis of Y. It is much steeper on one side than the other. The arithmetical mean does not represent the average diameter. The result shows that the curve is not that of the curve of probability which follows the law of variation in the physical world, but, in this particular case, follows the law governing biological variation. This difference between the laws of variation in the physical and living worlds has been nicely shown by Dr. C. S. Minot.[1] He shows that biological curves rise rapidly to their maximum and then fall on the other side much more gradually.

It will also be seen that over 50 per cent of the spores fall between 2.0 and 2.2, and that nearly 80 per cent fall between 2.0 and 2.5 inclusive.

A similar series of observations was made upon 300 pollen grains of *Acuida tuberculata*, but owing to the uneven surface there was more difficulty in making accurate measurements.

Divisions	5.0	5 5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Number	4	10	47	67	96	5.5	9	5	3	3	1

The observer should be careful to measure all the spores in a given field, otherwise there is a tendency to pick out the very large and the very small ones, thus giving these too great a representation.

[1] A. A. A. S., XXXIX., p. 271.

ON THE MEASUREMENT OF HALLUCINATIONS.

BY E. W. SCRIPTURE AND C. E. SEASHORE, NEW HAVEN, CONN.

IN an article on "Tests on School Children," by E. W. Scripture, in the *Educational Review*, 1893, V. 61, a test on suggestion was proposed, in which a wire was sometimes heated at a given signal and sometimes not. The observer, not knowing the facts of the case, was required to tell when the wire felt hot. When the wire was not heated, but the observer believed it to be heated, the time required for the hallucination to arise was measured.

This crude idea has been taken up on a larger scale this year, and measurements have been made on several persons in several ways. The work so far has been considered to be the preliminary or qualitative stage of the investigation. Before proceeding to the careful and laborious technical work necessary for exact measurements, which must necessarily take a great deal of time, we wish to secure priority rights as the first to measure hallucinations. In the first place, as the suggestion calling out the hallucination is a sensation or a compound of sensations, we can measure the intensity of the stimulus in the usual ways. In the second place, by finding that stimulus whose sensation is not perceptibly different from the hallucination, we measure the intensity of the hallucination. In the third place, by reacting to the hallucination we record the time required for it to appear; in more accurate work the reaction-time is to be subtracted from the total time, but as the hallucination-time in the cases already investigated ranges from seven to thirty seconds it was of no account. Our work has hitherto been confined to the weak hallucinations of sane people. We find very great differences, corresponding to classes of society and to training in scientific judgment. With abnormal persons we shall expect much shorter hallucination-time and much greater intensity.

ON ROOT HAIRS.

BY TH. JAMIESON, ABERDEEN, SCOTLAND.

During the past fifteen years, in the course of carrying out a very large number of experiments to ascertain the relative effects of different forms of manure, and also, which of the mineral chemical elements usually found in plants are essential, no point was more strikingly illustrated than the inability of the plant to grow in the absence of phosphorus, although all the other essentials of growth were fully supplied. In its absence, the turnip plant, for instance, reached the stage of forming only leaflets, while neighboring plants, treated in every respect in precisely the same manner, only that they were supplied with phosphorus in addition, developed large plants, yielding a crop of about 30 tons per acre. No laboratory or lecture room experiment could be more effective than the positive and negative results shown by two such plots, side by side, and these evidences have been abundantly repeated annually.

In following out an inquiry bearing on this remarkable action, a special microscopic examination of root hairs was suggested; special in respect of introducing various conditions of light and shade, even approaching darkness, as well, of course, as adjustments of the focus under various degrees of light. This is specially mentioned in order to indicate that the feature on root hairs about to be explained is such as might easily escape notice in an ordinary examination. An unlooked-for structure was thus detected, as a consequence of attention being so long concentrated on the tip of the hair and of gazing continually on the spot under cautious and slight alterations of both light and focus. It was seen that there was *a well defined aperture.* The aperture in the first case of detection was so clearly defined, and moreover seemed so clearly continuous with the inner membrane or tube of the hair cell, that no doubt was felt that there was an aperture. Possibly it would not have been discerned had it not been on an unusual part of the hair, viz.: a little below the point, so that the point formed a kind of cap. As a rule, however, the aperture is at the point.

So necessary is it to examine the root hair under varying conditions of light and focus, and also to travel along the inner lining of the tube with the eye till it reaches the point where the aperture ought to be, and so frequently is the aperture turned away from the point of view, that one familiar with the process can easily understand how any one not so familiar might rise from the examination and feel satisfied that the hair is, indeed, a a closed tube. Only persistence to continue, till the inexperienced observer falls upon a suitably placed hair, is followed by success.

After having observed so satisfactorily the first aperture, much time was spent during three years in examining the hairs of a large number of plants, and although from the state of the plant roots, and the condition and position of the hair, the aperture has frequently not been detected at the first examination, yet by another selection and persistent examination the aperture has been found without exception in the case of every plant examined.

On examination at this stage of the writings of the more eminent botanists on the subject, it was found that in few of these treatises is the detailed form of the hair gone into with sufficient minuteness.

The works of De Bary, Duchartre, Olivier, Gasparina, Van Lieghem, Sachs, Vines have been referred to.

The essential and accepted character given in all these works is: a complete and closed cell, thread-like in form and broadened at the base, where it is continuous with, and forms part of, the epidermis.

The more recent works by Schwartz, Zacharias and others dealing more particularly with root hairs have been examined, but the idea of an aperture does not seem to have occurred to them, and the negative evidence, of course, is not of any significance.

Referring now to the function of hairs as bearing on an aperture. None of the writers on the minute structure of hairs departs from the idea that the hairs are closed cells, or, as Sachs describes them, exceedingly delicate walled narrow tubes.

By accepting this view a difficulty arises. It has hitherto been found necessary to advance some explanation, for the well-known fact that the insoluble matter, such as phosphates, is assimilable by plants. Sachs says in explanation that these insoluble matters are without doubt dissolved in the thin layers of water which surround the particles of soil, basing this inference on the fact that water running off from the drained pipes of tilled soil contains these substances; but he infers further, that "since the nutritive materials clinging to the particles of soil are not soluble, or but slightly so in water, the roots must themselves effect the solution." This seems to be a kind of forced conclusion, *i. e.*, as the insoluble matter does get in, the particles *must* be dissolved, and, he asserts, without, however, giving grounds for it, that this solution is accomplished by means of the extremely thin membrane of the root hair being permeated with an acid fluid. Now, it is obvious that, it being once accepted that the root hair is a closed tube, and that side by side with this acceptance is placed the well-known fact that plants make use of insoluble matter, it becomes a necessity to assume, and it appears little more than an assumption, that the plants obtain their solids by the action of an acid. The usual statement is, not that the plant roots make use of an acid, but that they must make use of an acid, thus indicating that there was no other way of getting over the difficulty.

Van Tieghem also says that the roots set free an acid liquid which bathe their surface. He, however, undermines that statement by summarizing the functions of the root as a threefold action on the soil:

First—On the gases, by absorbing oxygen and disengaging carbonic acid.

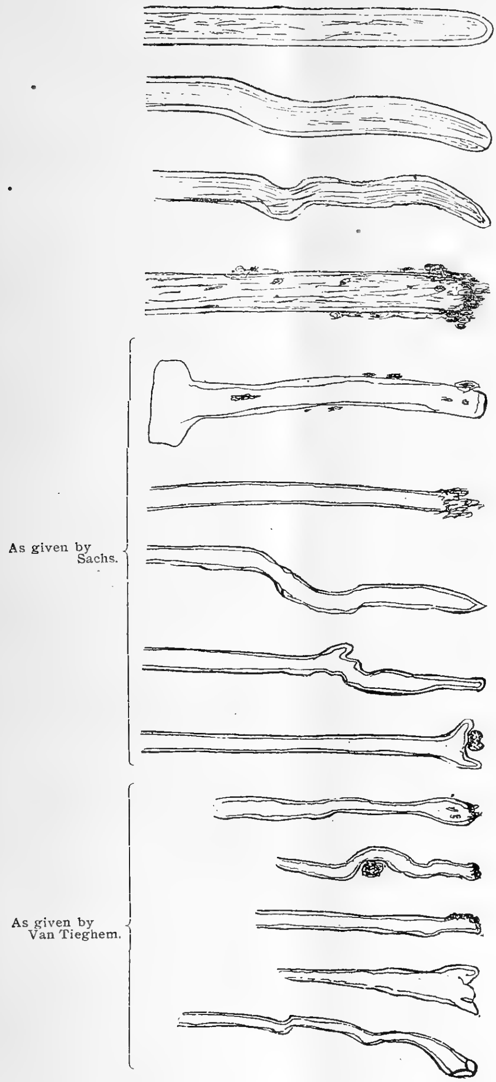
Second—On the water and dissolved matter, by absorbing them.

Third—On the solids, by dissolving them.

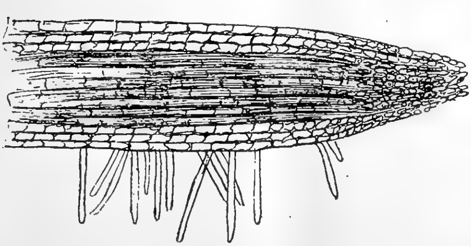
Now, it is evident that if the root acts so as to disengage carbonic acid, that acid alone is sufficient to account for the reddening of the litmus; and this circumstance takes away the support that such acid reaction might seem to give to the assumption that the plant forms an acid to dissolve the mineral food, unless, indeed, the dissolving acid be simply carbonic acid, in which case it would be uncertain whether the acid is there to dissolve insoluble matter, or is there as a simple product of decomposition. Vines asserts, however, that the reddening is permanent, and therefore is not due to carbonic acid.

Considering the slight evidence thus provided by Sachs and Van Tieghem, and that no observers seem to have found any special acid in the root, but simply acidity that may be accounted for by decomposition of the plant, or of organic matter in the soil, the dissolving action of the root hair seems to be little more than an assumption rendered necessary as an explanation of the well-known fact that insoluble matter is assimilated by the plant.

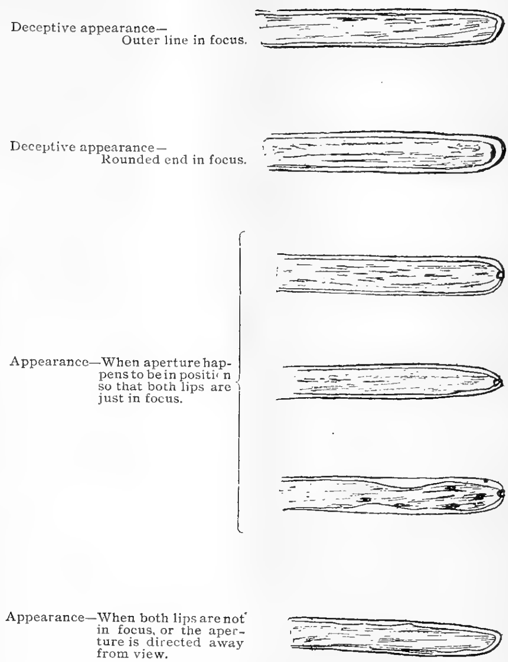
A difficulty in accepting the passage of solid particles by an aperture may seem to be presented by the consideration that, if solid particles enter the hair tip by an



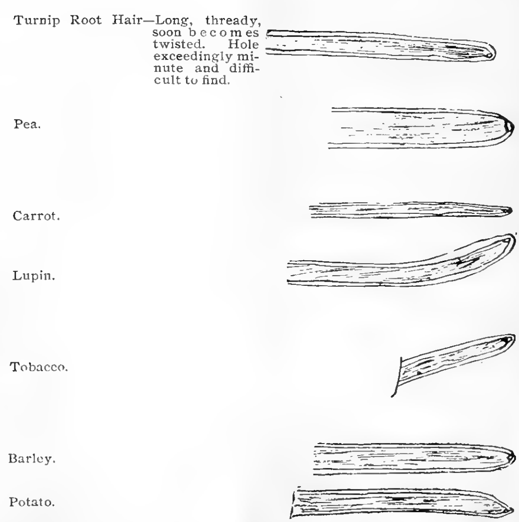
USUAL ILLUSTRATIONS OF ROOT HAIRS.



TIP OF OAT ROOTLET WITH ROOT HAIRS (much magnified.)



OAT HAIRS MORE MAGNIFIED.



USUAL FORMS OF HAIRS.

aperture, they must either be decomposed inside the cell, or there must also be an aperture at the lower end, or that the particles should be forced out (as is done by the amœba). There may, indeed, be such a basal aperture which it would be difficult or impossible to distinguish. But close examination of the base of the root hairs indicates that, although they may originate in an epidermal cell, the internal part of the hair seems to communicate with the deeper tissue, or possibly with the vascular tissue. Thus in examining the root hair of a carrot, the faint bluish-grey appearance of the central tube was seen to be continuous with the deeper tissue, though whether entering into a vessel, or simply passing between the cells, could not be distinguished. This relation of the hair with the deeper tissue is supported by the origin of hairs as described by Schwartz and Duchartre. But there is no real difficulty here, for it is known that decomposition takes place within the plant, and it may as well be done in a hair cell as any other cell.

Having now considered the literature on the subject, observations made on the aperture may be returned to. That there is a definite formation of an aperture with lips, I have satisfied myself in regard to a large number of root hairs, illustrations of which are given here, and it will be seen that they vary not a little, both in shape and position, being usually a minute circular hole at the extreme, and more or less tapered, end of the inner tube, with, of course, a correspondingly larger rim in the outer tube; but sometimes the opening is transverse, sometimes not quite at the tip, or, rather, the tip seems half curved, making the aperture appear slightly at one side, and the tip to appear like a lip or knob.

Mangold—Branched.

Particles seemed drawn within and hair grown round it. Hole on side.

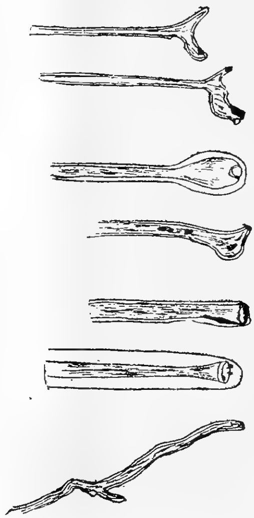
Mangold.

Grass.

Beet.

Potato.

Turnip—Branched.



UNUSUAL FORMS OF ROOT HAIRS. (Rarely occurring in the above plants.)

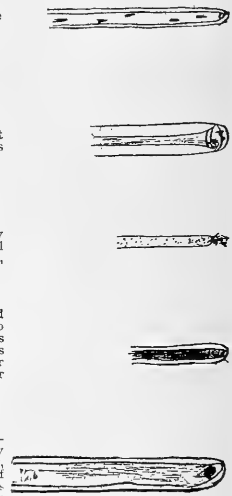
Grass—Particles frequently seen inside occupying line of inner tube.

Pea—A peculiarly formed hair. At times, when hole large, particles may be seen lying on lip.

When hairs are allowed to dry under the object glass they shrivel up and often discharge contents, and this discharge is at the tip.

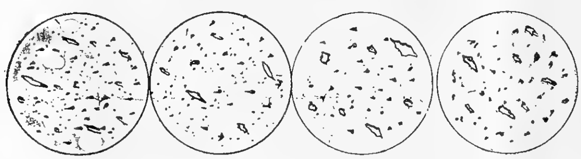
When litmus solution is passed under object glass it seems not to affect outer tube, which remains greenish, while inner tube becomes tinted, hence the coloring matter seems to pass not through outer membrane, but by the hole.

In one case was seen very distinctly a piece of matter half way into the tube of Pea root hair, which is large; the darker tint of the half lying outside indicated, as well as the rim of hole, that the other half was inside.



ENTRANCE OF PARTICLES INTO APERTURE.

Apatite. Slag. Steamed Bone Flour. Coprolite.



	Actual Number in Field.				Number Per Cent.			
	Minute.	Small.	Medium.	Large.	Minute.	Small.	Medium.	Large.
Apatite	43	17	3	43	65	25	4	6
Slag	13	21	4	3	32	50	10	8
S. B. flour	110	15	3	2	86	11	2	1
Coprolite	56	35	8	4	56	34	7	3

STATE OF DIVISION OF MANURES EFFECTIVE ON PLANTS. (Apative—crystalline—only slightly so.) Showing that in these manures there are particles so minute as to be able to pass into aperture of root hairs.

LABORATORY WORK BY THE STUDENT OF CHEMISTRY SHOULD BE SUBORDINATE AND AUXILIARY TO THE DEVELOPMENT OF FACTS, PRINCIPLES AND THEORIES BY THE TEACHER.[1]

BY R. W. JONES, UNIVERSITY OF MISSISSIPPI.

THOSE of us who are engaged in teaching chemistry recognize the fact that it is a difficult subject to teach scientifically; it is ofttimes hard to make its lessons clear to the mind of the student; difficult to employ it with its due power as a means of intellectual discipline and an element of general, liberal education; and yet it has a place, an accorded place, in every properly arranged scheme of education: no such scheme is complete without it, and no one can be said to be liberally educated who has not learned the elements of this science; for without the knowledge of these elements, at least, it is impossible to read understandingly the literature of our day and to appreciate a thousand things of common occurrence in respect to health, well-being and progress. The practical utility of chemistry is unquestioned; but some question its disciplinary value as an element of general education. In my opinion, the skillful teacher makes its value in this regard equal to the languages and mathematics, and gives to the mind exercise and truth which in character are peculiar and in quality most valuable.

The great value of the study of general chemistry turns solely on the adoption of good, sound methods of instruction.

The nature of the subject, the inquiry into strange forces, into marvellous activities and changes, give to it, in the eyes of beginners, the appearance of the mysterious, making it seem, as it did to the Egyptians, a "Black or Secret Art." The puzzling vastness of the number of facts, the important and interesting relations between them, the comprehensive laws, the profound theories, tax the powers of the capable and patient student. The teachers and the writers of text-books often find it difficult to decide what to use and what to omit of this profusion of material. The subjects can be so selected, the matter so arranged with due regard to the time at our disposal and such methods of instruction employed that no other subject could be profitably substituted for the study of chemistry.

The methods of teaching general chemistry have varied greatly at different times and now vary more or less in different schools. Of course, each teacher carries his personality into his class room: this is right and inevitable; there are differences of method which are broader, proceeding from difference of standpoint and difference of view both of the object to be accomplished and the way of reaching it.

We cannot emphasize too strongly the general disciplinary value of the study of chemistry and its essentiality to culture; and it devolves upon us to maintain the correctness of our estimate by the intellectual and industrial results of our teaching. The first object is to use chemistry in a scheme of education to make intellectual men, and the second is to prepare skilled chemists.

After noting these differences of method, I am sure we may all agree that the feature which specially characterizes the teaching of chemistry at present and which distinguishes it from the method of past years is experimentation by the student.

And yet in many high schools and *colleges*, even in this day, the effort is made to teach chemistry without experiments either by the instructor or by the pupil. Many of these schools and colleges have no apparatus. Such teaching of chemistry and of science generally is illusory. Chemistry is justly and highly valued in its general study as an element of disciplinary power and as a foundation for special attainments; but its most earnest and intelligent advocates in a course for a well-rounded education would admit that it would be far better to omit it altogether than to teach it in that irrational manner without experiments, and to devote the time thus saved to the study of some subject which can be scientifically taught without apparatus.

As teachers, we must insist that an experimental science, such as chemistry is, cannot be taught without experiments.

In my judgment, the best method of teaching general chemistry, in the earlier part of the course, the best way of laying a substantial basis of knowledge that is reliable and definite, on which the student can subsequently build most surely and rapidly, is for the professor to give in didactic style oral lectures, adapted to the comprehension of his class, setting forth in order the most important portions of the great body of established facts, connecting them by threads of scientific relation, that bring them into a simple unity, illustrating them by experiments, on the lecture table, which cover all essential points and help the minds of students to apprehend them as real.

A really good text-book is very valuable, and the instructor ought either to follow the order of subjects in the text-book or be careful in assigning the readings so that the lectures and text-book will each day cover the same ground substantially. Otherwise confusion of thought will arise in the student's mind.

To indicate something of the scope of instruction I would say that there should be a clear presentation of the nature of chemical science, its relation to other sciences, and the ways of doing the work: there should be a discussion of the elements and their most important, best known compounds: as the teacher's knowledge covers his whole course he is able to call attention to that which is essential and that which may be at the time incidental, to note the connection between facts, the relation between substances, and thus to systematize and organize knowledge and build up the science in the minds of students: this prepares the way for the proper presentation and discussion of laws and theories, for calling into vigorous exercise the faculties of comparison and judgment. He can exhibit the method of properly guarded generalizations and formulations of his teachings; his duty and plan are to guard the student against the presumptuous thought that one man can make experiments to cover all the facts and phenomena and demonstrate all the laws of chemistry, and to impress on the mind respect for the work that has been patiently done by others and thus give a just regard for authority, through which so much of our knowledge comes in every department of inquiry: the pupil learns that for a satisfactory demonstration of chemical truths he needs a large complement of facts and processes.

At each meeting the class should be questioned upon the matter of previous lectures and readings; skillful repetition is needed to make distinct and abiding impress of the truths, to wear off the strangeness of the subjects and to get a lodgement of the facts and principles.

The careful keeping of notes, subject to periodical inspection of the teacher, the writing of chemical reactions and the solution of problems constitute an important part of that instruction which is necessary to exactness in method and clearness of understanding. It goes without saying that the student must be taught to

[1]Read before the International Congress of Chemists, Chicago.

make experiments. But in order to carry out this plan, the experiments to be made by him should be connected with the course of instruction and should be definitely related to the experiments given on the instructor's table. Indeed, the relation should be so close that a knowledge given by the instructor's experiments would be in large measure a guide to the performance of the student's experiments and that without it the successful performance of the practical work by the student would be beyond his power. This insures the closest attention and care on the part of the student to get the professor's instructions; it trains the mind to correct observation, concentration of energies and carefulness in drawing conclusions.

In the beginning of a course in general chemistry and for two or three months, one hour of laboratory work by the student to four hours of such instruction by the professor, as I have outlined, will be a good division of time. As the student's knowledge of the subject increases and his manual dexterity in handling apparatus improves, his working hours should increase. This mode of instruction proceeds on the rational assumption that the pupil needs to be instructed; it will furnish him the largest amount of reliable, systematic, classified knowledge that is attainable in a given time and give him the best foundation for extended scientific study.

Other special advantages of this mode of study will appear by comparison.

Many excellent chemists make laboratory experiments by the student the starting point and the centre of all instruction. Their idea seems to be to make the student do his own work, draw his own conclusions and thus instruct himself: the instructor, according to this method, gives him the fewest practicable hints and directions. In furtherance of this plan of instruction many "laboratory manuals" have been written which contain a great profusion of experiments: in many cases these are poorly arranged. In the preface to one of these "manuals," now open before me, I find these words: "The teacher should be but the guide that points out the right path, calling attention to the bypaths of error." This plainly implies that if only the direction be pointed out, the student can make the trip. This plan puts the student forward to work for unknown truth; it holds out to him the idea that in some sort he is an investigator, when in reality at first his work should be to learn what others have brought to light and how they have done it.

The objections to making the laboratory work of the student in the beginning the leading and independent method of learning chemistry are numerous and strong: 1. It involves an unnecessary consumption of time. 2. It assumes that the student can do properly what, in the very nature of the case, is well-nigh impossible. A certain amount of knowledge is necessary to the acquisition of other knowledge under the best conditions: there is hardly any fact more palpably true than this.

A student of algebra could hardly be expected to solve problems of any degree until he had the preliminary operations and rules that had been established by the patient work of strong, industrious minds. A traveller, ignorant of the topography and history of Rome, her archæology, her classic and Christian art, would not be profited by a visit to the famous city: he would stand unmoved before the ruins, the historic arches and temples and the treasures of her splendid galleries. A man sees what he has eyes to see. This principle applies in the study of chemistry. An untaught youth knows not what to expect, what to look for in an experiment; he sees things and knows not what is essential and important and what incidental and accessory. Many things he fails to see because he knows not what to look for and how to look. This brings him into a hesitating, doubting state of mind which is very unfavorable to definite, strong impressions. He does not know the significance of those actions which he observes, and he is unable to give them scientific interpretation and impression.

Chemistry is a great science, difficult to master: it has risen upon stepping stones of errors and obstacles by the continued efforts of great men. For centuries minds of able and laborious investigators reached out after the truth and battled against error. The advance from the unknown to the known has been very slow.

Glauber's "Sal Mirabile," Shahl's "Phlogiston" and various other propositions and hypotheses, strenuously advocated and rejected, tell us of the intensity of the struggle and how the mists of uncertainty hung over their work. But when Lavoisier availed himself of the labors of others, patiently compared facts with facts and generalized scientifically, he saw a new light, and the birth of modern chemistry was announced; chaos gave place to order; principles became harmonious.

In view of all this, is it not erroneous to require a student in the very outset to make and interpret experiments as the means of getting knowledge and to proceed with the most meagre knowledge to classify phenomena? Students at first should be put in possession of that knowledge which is their just inheritance from the history of the past and should have the opportunity of learning the methods of experimentation adopted by the builders of the science, and from this study of facts and principles and modes of manipulation to acquire the power of orderly thinking and get the key to higher and greater treasures.

When one wishes to enter upon research he carefully inquires what has been done already; he gets the bibliography, and learns the methods of investigation in that line that have been most fruitful of results: not uutil he has come to this point is he ready to enter upon the work which he proposes.

The object of work in the laboratory by the student in the beginning is to learn to use apparatus: his instruction must come mainly from the skillful teacher: the teacher is not merely "a guide" but a positive power in instruction, an intellectual quickener. The work of a student left to himself in the laboratory profits but little.

ORIGIN OF THE HYDROCARBONS.

BY MARCUS E. JONES, SALT LAKE CITY, UTAH.

A RECENT review of the paper of Dr. Engler on this subject in *Science* is an interesting one, as it is in the line with my own observations on that subject in Utah. The time-worn theory of the origin of our Utah hydrocarbons from coal has been repeated by several persons in *Science* during the past year, but unfortunately there is hardly a particle of evidence of such origin. I do not know of a single deposit near our coal beds in Utah, with perhaps the exception of one bed of impure asphalt, which seems to be close to the Dakota group, but may have come down from above, as it is not certainly interstratified with the Cretaceous beds. With this exception I do not know of any deposits of our hydrocarbons that are earlier than the Miocene Tertiary. There are some places where it is not possible to certainly tell whether some sandstones are Eocene or Miocene where asphalt has collected from adjacent beds of shale or clay. In using the word "near" it is used in a geological sense, i. e., stratigraphically near. There are some hydrocarbon beds which are within perhaps one-half a mile of the upper coal beds but separated from them by the whole thickness of the Eocene and considerable of the Cretaceous. Again these deposits are always in the immediate vicinity of large deposits of bituminous shales or clays quite full of fish bones and the like but showing few or no vegetable remains. That a distillate should have come up from the far underlying Cretaceous coal beds through fissures and have spread out in certain beds only of the Miocene, while exactly the same conditions as to permeability prevail throughout the upper Cretaceous and Eocene with no hydrocarbons, would of itself preclude the supposed origin even if there were great fissures through which the material could come. In addition, however, there are no fissures cutting the formations where the deposits occur ; the beds lie almost and often quite horizontally and show no signs of disturbance for the most part. Here and there are little irregular seams very rarely more than a foot wide, though in one case four feet wide, into which the hydrodarbon has oozed from the surrounding clays and made a deposit of the pure article. Were these fissures, which are evidently only local and shallow, the source and not the receptacle of the hydrocarbons, then the surrounding shales and clays would be saturated most at the point of contact and less and less as the distance from them increased, but the fact of the case is they are if anything less saturated at the point of contact and fully as much impregnated miles away from any fissures. Wherever we find even a seam the thickness of a knife-edge in these beds we find hydrocarbons, and where they are absent we find no deposits of hydrocarbons at all. The only beds which show a thinning out of their contained asphalts are the sandstones, which are nowhere evenly impregnated but are full of asphalt only where there is a crack or fissure leading up or down to the bituminous beds in the immediate vicinity. There are also several places where crude asphalt has oozed out of the sandstones and formed from a thousand to a million tons of matter more or less pure, assaying from 11 per cent to 75 per cent crude asphalt ; the larger deposits are still flowing slowly, perhaps a barrel a day or the like. This material when it first comes out carries a large percentage of the more volatile hydrocarbons and considerable of the paraffine series, while the fixed carbons are low. To my mind these have the same origin as the other deposits, the connection with the overlying bituminous beds being very extensive through the small seams in the sandstones and the means of exit being the gentle slope of the beds. That the asphalt is composite is due either to the quantity and its wide origin or to lack of facilities for the volatilization of the lighter elements. Another remarkable feature in our hydrocarbons is that no two deposits so far discovered in Utah are alike in their chemical composition excepting the asphalts just mentioned. The so-called ozokerite at Pleasant Valley Junction is black and somewhat flaky, containing an excess of fixed carbon for one of the paraffines. Some fifty miles south is a deposit a few inches wide, containing a paraffine as pure as beeswax and of the same color, approaching closely to the typical ozokerite. At a place near Pleasant Valley Junction there are quite a number of seams of the asphalt series and one place where it oozes very slowly out of a layer in the bituminous shales and forms little balls which at length break off and roll down the slope. These have about the appearance of pure Trinidad asphalt and go low in the paraffines and contain small percentages of the lighter hydrocarbons. In the same region are several seams of the pure asphalt, none of them workable, in which the matter is as pure as the Uintahite or Gilsonite of commerce and has a fracture varying in the various seams from cubical to conchoidal, according to quantity of contained paraffine. A few miles farther north, but in the same geological horizon, are the only known deposits of what has recently been called Wurtzellite, which is an asphalt with an excess of paraffine. Some 100 miles farther, but in the same horizon, are the great deposits of Uintahite or Gilsonite, which has become so well known as a varnish and insulator. In my judgment these variances in composition are due to local causes, affecting the matter as it has oozed out of the shales into the crevices which have received it, such as exposure to the air, oxidation, etc.

Though the theory of the animal origin of our hydrocarbons, which was long ago ably advocated by Professor Newberry, seems to be the only tenable one, it must not be taken as proved by any means, for I have never yet seen sufficient remains of animals to account for the quantity of our hydrocarbons, though there may be sufficient in the beds as a whole. A significant fact is that these beds contain multitudes of tracks of birds and mud cracks indicating their being nearly on a level with the water. It is possible that many of the bones have disappeared by decay ; this is plausible, since I have never found the bones of any animal intact but always scattered, broken and tangled in wild confusion, and yet plentiful.

The above remaks apply to the hydrocarbons of which mention has been made in *Science* and other journals. They are not the only ones in Utah, however. At the base of the Cretaceous, or at least as low as the base of the Colorado of Emmons, are other hydrocarbons wholly different from those mentioned above, which are nearly identical with the petroleum of the east, containing more paraffine only. So far they are not known to be extensive. In one locality there seems to be natural gas, but with what pressure is not definitely known,

In Salt Lake Valley is quite an extensive local deposit of natural gas of Pliocene age giving a pressure of at least 200 pounds to the inch. Its composition does not vary materially from that of the east, though it seems to give more heat and less flame.

BIRDS SELDOM SEEN IN SOUTH CAROLINA.

BY PROF. J. C. HARTZELL, JR., B. S., M. A. O. U., ORANGEBURG, S. C.

For some time the writer has been endeavoring to make a list of those birds that are uncommon in South Carolina. The undertaking has proved a very arduous task. The following is a partial list as the result of the undertaking. A fuller list is not given on account of the unsatisfactory data of a few species observed. The majority of the species noted below are in the writer's possession:

Clangula hyemalis ; A. O. U. 154. Bays and coast in fall and winter. Food, shell-fish. Nest in long grass. Eggs bluish-white.

Grus americana ; A. O. U. 204. Salt marshes and swamps. Food, Indian corn and sometimes mice. Nest on the ground. Eggs pale blue, spotted with brown,

Bonasa umbellus ; A. O. U. 300. Hills, northwestern part of state. Nest under fallen log. Eggs white.

Aquila chrysætos ; A. O. U. 349. Food, mammals and birds. Mountains in northern part of state. Nest on ledge of rocks. Eggs whitish.

Archibuteo lagopus sancti-johannis ; A. O. U. 347a. Open fields. Nest in tree. Eggs whitish and drab. Food, field-mice.

Strix partincola ; A. O. U. 365. Marsh lands and meadows. Food, rodents. Nest in old building. Eggs whitish.

Contopus barealis; A. O. U. 450. Pines and fruit trees. Food, insects. Nest in fork of pine tree. Eggs creamy with brown spots.

Corvus corax; A O. U. 486. Inaccessible cliffs. Food, birds, mammals and grains. Nest in very tall tree. Eggs light green, clouded with brown.

Plectrophanes nivalis; A. O. U. 534. Mountains. Nest in crevice of rock. Food insects in summer, seeds in winter. Eggs so varied in marking as to be indescribable.

Ammodromus condacutus; A. O. U. 549. Salt marshes. Food, shell fish and small crabs. Nest in grass. Eggs bluish white with brown spots.

Ammodromus maritimus; A. O. U. 550. Coast Nest on ground. Eggs grayish-white with brown spots. Food, shell fish.

Petrochelidod lunifrons; A O. U. 612. Jutting eaves. Food, insects. Eggs white with reddish-brown spots.

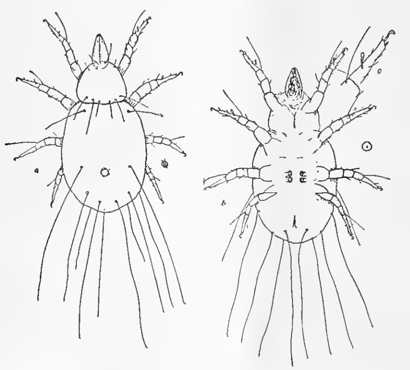
Vireo pheladelphicus; A. O. U. 626. Food, insects. Did not see nest or eggs.

Sitta canadensis; A. O. U. 728. Pine forests. Food, seed of pine tree and larvæ of insects. Nest in stump. Eggs bluish-white, with light red spots.

A NEW MITE INFECTING MUSHROOMS.

BY HERBERT OSBORN, AMES, IA.

Some time since I received from Professor J. A. Lintner specimens of a mite which had been found infesting mushrooms quite seriously, and from its habits and the statements concerning its numbers it is likely to prove a very important pest of this crop. From the literature which is available it does not appear to be described and is certainly different from the species described as infesting mushrooms in Europe. It approaches more nearly to the *Tyroglyphus phylloxeræ* of Riley but is quite different in many structural details. Since it is likely to prove of importance it seems desirable to describe it, even though it may possibly prove identical with some of the described European forms.



Tyroglyphus lintneri, n. sp.
a, dorsal view. b, ventral view. c, tarsus, much enlarged; length shown in circle to right.
From nature, by H. Osborn.

Tyroglyphus lintneri, n. sp.—The mandibles are large, chelate, strongly toothed, the palpi terminating with a strong hook, the tarsi hooked with no sucker visible, the last segment long, slender, spiny at tip and on the two anterior pairs bearing a clavate appendage. The hairs are very long, those on the posterior part of the body equal to or greater than the length of the body and their origin marked by chitinous rings, six located on the posterior portion of the anterior division of the body and standing quite erect, ten on the posterior portion, two at anterior angles, two behind the middle and others near the margin on the posterior third of the body, abdominal suckers four, located between the abdominal legs.

This species differs from *T. phylloxerae* Riley, particularly in the greater length of tarsal joints, greater curvature of tarsal claw and the much greater length of the hairs, those at the end of the abdomen being as long or longer than the body, while the *phylloxerae* Riley describes as about one-third the diameter of the body. It is also larger than specimens I have determined as phylloxeræ, and the second pair of legs is further back on the body than shown in Riley's figure.

I have named it in honor of Dr. Lintner, who has taken a most lively interest in the various forms of acaridea, besides having made many valuable observations on these and other important insects.

THE ARCTIC CURRENT IN THE ESTUARY OF THE ST. LAWRENCE.

BY ANDREW T. DRUMMOND, MONTREAL, CANADA.

The great Arctic Current of northeastern America takes its rise in Baffin's Bay and, after skirting with its broad surface the coasts of Labrador and Newfoundland, appears to largely lose itself as a cold surface current, as it impinges on, and, in part, parallels, the Gulf Stream. Every traveller to America by the St. Lawrence route has his attention drawn forcibly to it by the coldness of both the atmosphere and the water, and by the presence of the picturesque icebergs, which, though floating slowly southward with the current, suggest to the imagination a broad submerged mountain chain with the glaciered topmost peaks and snow-clad pinnacles alone left to view.

As the great steamship passes inward to the Gulf of St. Lawrence by the Straits of Belle Isle, the traveller is equally struck with the fact that although the current appears to have been crossed, huge bergs are still met with, floating in a new direction toward Anticosti. The explanation is that a branch of this Arctic or Labrador Current finds its way through the Straits of Belle Isle and past Anticosti to the River St. Lawrence, up the estuary of which it ascends on the northerly side toward Quebec. On the way it meets with and is tempered by the warmer waters coming from the Great Lakes above, as they pass outward to the sea, and returns on the south side of the estuary as a modified current, which, after skirting the Gaspe Peninsula, is finally lost in the Gulf of St. Lawrence. This is the substance of our present knowledge.

The temperature of the water in the estuary of the river becomes interesting as bearing on the existence of this current. During the early part of August, last, the opportunity presented itself at Murray Bay, on the north shore, of obtaining some surface and bottom temperatures. The instruments used were Negretti and Zambra's reference and deep-sea thermometers. The conditions on the 5th of August, when the following readings at different points were taken, were those of calm air, clear sky, and fairly strong sun; the time, 8 A. M. to 8:30 A. M., and the position about a mile and a half off Cap a l'Aigle, a jutting headland four miles below Murray Bay village:

	1	2	3
Air	59° F.	——	59½° F.
Water on surface	46¼°	46½° F.	46¼°
Water at 17 fathoms	——	——	38¼°
Water at 18 fathoms	38½°	——	——
Water at 31 fathoms	——	38½°	——

Whilst the surface water at this distance from land was comparatively cold, at the shore at Cap a l'Aigle, where it flows and reflows over the rocky shallows, its temperature on warm days was generally from 53° to 60° F., thus admitting of bathing on the part of the summer residents.

LETTERS TO THE EDITOR.

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

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

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

A Rope of Maggots.

The following bit of experience is given in the hope that some well-informed person will shed light upon the subject.

I was hurriedly passing through a wood one damp summer morning when my attention was drawn to what appeared to be a piece of rope lying among the leaves. It was not at all unusual to find short pieces of rope in the pastured woods, but something unusual in the appearance of this one attracted my attention at once. It was moving! not in a forward or backward, nor in a sidewise, direction; nor rolling over, nor in the least changing its position or shape. In the dim light of the woods I could make it out only by stooping down with my face close to it. Then I discovered that it was composed of maggots!

The rope tapered like a whip-lash, which it very closely resembled, being about five feet long, nearly two inches in diameter at the large end, fully two inches at the largest part, and tapering from there to a thin line at the "lash" end. It was in the form of a section of a circle about twenty feet in diameter.

Each maggot seemed to be in motion toward the large end, wriggling over or between or below his fellows. During the five minutes that I watched them there was an advance of four inches, the van of the mass wriggling on the leaves ahead of the rest.

My first thought was that they were feasting on the cadaver of a snake. But there was not the least evidence of a snake. Since all seemed to be migrating, I concluded that they had finished one mess and were seeking another. But I was unable to find anything which they could have hatched in or come from, in any direction, nor any hole whence they might have issued. For nearly two feet in the rear of the moving mass there were traces of them, indicating that they had travelled over that space. Further than that no traces could be found.

Some questions naturally suggest themselves. If the maggots were really migrating, how came they to be in that shape rather than spread out over a larger surface? If they simply occupied carrion which assumed this shape, why were they all moving in one direction? It is not at all unusual to see a great mass of maggots move simultaneously when there is some exciting cause. But these did not have that appearance. They were trying to get somewhere! If they had been feeding upon carrion, why should there be not the slightest remains of it? I hope that some one may be able to throw some light upon this. As near as I could determine, the maggots belonged to the *genus Musca*, and very closely resembled, if they were not identical with, the common house fly (*M. domestica.*)

Lynds Jones.

Oberlin College, Oberlin, Ohio.

Singular Behavior of an Owl.

When collecting plants in the summer I came across an owl standing at the base of a small shrubby oak in a thinly wooded pasture. It was discovered when about twenty feet away, and was cautiously approached in order to get a better view, and to see how it would act. When I had come within eight or ten feet it fluttered away about as far in the opposite direction, turned partly on its side and spread its wings a little, much as a wounded or fallen bird does. I went up to it, took it from the ground and carefully examined it, expecting to find some wound or mark of disability for flying, but could find none. While doing this it was held in the hands either by the wings, feet or body, the bird quietly submitting or only slightly flapping the wings. After satisfying my curiosity I set it down, not wishing to carry it about all day in order to take it home, for it was not yet noon. To my surprise it immediately flew off several rods with as much apparent ease as any bird possessed. I watched to see where it lighted, and found it in an open place amid the rushes of a dry slough. Being curious to see whether it would repeat the former tactics, I again approached it cautiously, but got scarcely as near as before, when it took wing again and flew still farther off. It was sought once more, and found in a similar place, but had become more wary, so that I could not get very near before it flew so far away that I did not care to follow it up, having become well satisfied that the owl was physically sound, and knew quite well how to care for itself.

It at once became a question why the bird had acted so strangely at first. Was it surprised and bewildered, or dazed by the sunlight, or did it make a deliberate effort to deceive? To decide by the behavior, since one cannot tell what may be passing in the bird-mind, the last offers the best explanation. Though walking quite briskly when the owl was first seen, I at once checked my step, and paused for a little before going nearer. The bird evidently saw me about as soon as I saw it, for its face was towards me, and it watched my movements. How well an owl can see in the day-time I am not prepared to say, though it readily perceived me by some sense on the two subsequent occasions of approach when I was quite a piece away. Hence the attitude it took, its non-resistance when taken in hand, and its submissiveness when undergoing inspection, led me to infer that the owl wished to pass for a worthless fellow, if not dead, and cause me to go by and let it alone. But it evidently came to a different conclusion after the first trial and did not care to run further risk, or trust me longer. From its size and markings it was judged to have been the short-eared owl, *Brachyotus palustris* of authors.

E. J. Hill.

Englewood, Chicago, Dec. 22, 1893.

On Carib Migrations.

In *Science*, Dec. 15, p. 334, it is said, referring to the Caribs, "It would seem strange if a people who could navigate the Caribbean Sea in large open boats were incapable of crossing from Cuba to Florida."

The assumption appears to be that some Caribs lived on the island of Cuba. What authority is there for this? Is it any more strange that the Caribs did not reach Florida than that the Mayas and the Island Arawacks did not? Both of whom were equally skillful navigators. Or, because they were capable of doing so, are we to assume that they did? Not an element of the Carib language has been found anywhere north of the Isthmus of Panama.

D. G. Brinton.

Philadelphia, Dec. 27.

Pocket Key of the Birds of the Northern United States.

In the notice of my "Pocket Key of the Birds of the Northern United States" in *Science* for Dec. 15 it is said that it "will enable a student of nature to determine the family and usually the genera of any of our northern birds."

As it attempts to trace them all to the *species*, I think the notice should say so, and, if it is a failure in that attempt, say that also, and not lead readers to think I would write a book to enable a hunter to find out merely that the bird he shot is a snipe rather than a duck.

AUSTIN C. APGAR.

Trenton, N. J., Dec. 27, 1893.

BOOK-REVIEWS.

The Science of Education, Its General Principles Deduced from Its Aim, and *The Aesthetic Revelation of the World*. By JOHANN FRIEDRICH HEBART. Translated from the German with a Biographical Introduction by Henry M. and Emmie Felkin and a Preface by Oscar Browning, M. A. Boston, D. C. Heath & Co. 268 p., 1893.

PROBABLY no feature of our intellectual culture and of our advancement in higher education is so significant as the growing library of pedagogics in this country. For a number of years this department of thought has been sadly neglected with us, while abroad it has long received due attention as a most important factor in philosophic progress. Particularly with the German thinkers has this subject proved most fruitful, but, unfortunately, the peculiar difficulties of philosophical German have limited the English-speaking readers of these works to a favored few who, maybe, from residence abroad have acquired that thorough knowledge of the language necessary. Mr. and Mrs. Felkin have certainly then earned the applause of all teachers and thinkers by their careful and conscientious translation of these most valuable works of Hebart. Hebart himself is known by little more than name in this country, though some may recall him as a former professor at Göttingen, whose works on psychology and education are of great value; and yet as a metaphysician, psychologist, philosopher and teacher few men are deserving of so much careful study.

In the introduction to the present work we have a charming biographical sketch of the author, revealing in its carefully selected details glimpses of the inner man and offering a series of pen pictures of great value and assistance to the proper appreciation of the discussion which follows. Through his childhood, at Jena, at Bremen, at Göttingen, at Königsberg, we follow the author in his development, if development it can be called, when from their inception his theories seem to be those of mature growth and profound contemplation. Following this entertaining sketch the translators have given a review of Hebart's philosophy, together with a synopsis of the two works which follow and form the principal portion of the book. The review has evidently been written from a thorough acquaintance with Hebart's writings and is an additional aid to our understanding of his principles. "The whole aim of education, according to Hebart, is contained in the one word, morality. Its whole work is to form a character which in the battle of life shall stand unmoved, not through the strength of its intermal action, but on the firm and enduring foundation of its moral insight and enlightened will." "Proceeding from morality as the highest aim of humanity, and consequently of education, the essence of formation of character is defined as 'a making' which the pupil himself discovers when choosing the good and rejecting the bad. This rise in self-conscious personality must take place in the mind of the pupil himself, and be perfected by his own exertion. To place the power already existent, and in its nature trustworthy, in the midst of such conditions that it must *infallibly* effect this rise, is what the teacher must conceive as possible—while he must consider the great work of all his efforts is to reach, understand and guide that power."

Industrié des Cuirs et des Peaux, Analyse des Matières Premières, des Agents Auxiliaries et des Products. Par FERDINAND JEAN. Paris, Gauthier-Villars et Fils. 195 p., 1893.

Fabrication des Vernis, Application à l'Industrié ét aux Arts. Par LAURENT NAUDIN. Paris, Gauthier-Villars et Fils. 200 p., 1893.

Decoration Céramique au Feu de Moufle. Par M. E. Guenez. Paris, Gauthier-Villars et Fils, Quai des Grands-Augustines, 55. 199 p., 1893.

We have already noticed in these columns previous numbers of the *Encyclopédie Scientifique*, of which these present volumes form a recent addition, and further remarks on the general excellence of the plan adopted would be unnecessary. The detailed but concise descriptions of the individual arts and sciences, with separate volumes, each devoted to some particular speciality or division of the whole, and each complete in itself, is an undertaking sufficiently vast to make a doubt as to its success perfectly natural. But under the directorship of M. Leanté, Membre de l'Institute, and of M. Masson, editor, this success has certainly been attained, and we are presented with a series of works each superior in its particular field, and of value to a specialist as well as to the general reader. The first volume, treating of the tanning industry, naturally appeals most strongly to the manufacturer and to the chemist. The discussion consists, in brief, of the study of the crude materials and the chemical products which are introduced, of the theory of the successive operations of manufacture and their practical manipulation. Methods of analysis are also given, and in such a manner as to be intelligible to the manufacturer as well as to his chemist.

The manufacture of varnishes, by M. Naudin, is divided into two parts, the first treating the theoretical side and including the analysis of the resins and oils, with brief notice of the manner of extraction of the same, and their origin both geographical and botanical. The second part treats of the principal processes of manufacture actually used in this branch of industry.

The art of china and pottery decoration is so widespread and includes among its devotees so many amateurs, as well as those working upon a larger scale, that this little book of M. Guenez will doubtless prove profitable to many readers. Those "little points" which one soon discovers to be so essential to success are here described in principle and in practice, and by an understanding of the cause of the failure repeated disappointment is avoided. In pursuance of this plan the first part of the book deals with the theory or chemistry of china painting, while the second describes in detail the methods used in practice. While sufficiently popular to prevent no serious difficulties to the amateur, this book is of greatest value to the industrial worker.

NOTES AND NEWS.

Mrs. J. R. Green's "Town Life in the Fifteenth Century" is nearly ready. It will be of undoubted interest to the general reader as well as to the student of political economy, dealing, as it does, with the days when the towns were independent communities and centres of political life. "There is nothing in England to-day," writes Mrs. Green, "with which we can compare the life of a fully enfranchised borough of the fifteenth century, . . . a state within a state, boasting of rights derived from immemorial custom and of later privileges assumed by law."

—Mr. J. Norman Lockyer, the author of "The Meteoritic Hypothesis," "The Evolution of the Heavens and the Earth," and many other important works, has in press a new book, "The Dawn of Astronomy." It tells of the days when wonder and worship formed the prevailing feature in any consideration of the heavenly bodies; and it traces in Egypt and Babylonia, in China and India, the beginnings of the scientific treatment of the subject. The numerous illustrations lend another feature of interest to this delightful book.

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QUERY.

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

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N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE

NEW YORK, JANUARY 5, 1894.

RIVER COURSES IN THE JURA MOUNTAINS.

BY EMM. DE MARGERIE, PARIS, FRANCE.

It is well known to readers of *Science* that Prof. W. M. Davis, in his admirable analysis of the origin of the Valleys of Pennsylvania (National Geogr. Mag., Vol. I., No. 3, 1889), started from the assumption of a purely consequent, original course for the rivers which have excavated most of the Appalachian Valleys. As an illustration of such a kind of drainage system existing at the present time the Jura Mountains were given, following a statement published by Col. de la Noë and myself in our joint work, "Les Formes du Terrain" (Paris, 1888).

More recently, however, Prof. Davis has been led to change this view, according to the results reached by Mr. Aug. F. Foerste, in his valuable account of "The Drainage of the Bernese Jura" (Proc. Boston Soc. Nat. Hist., Vol. XXV., p. 392–420, 1892).

While admitting that Mr. Foerste has clearly shown that the River Birse could not have taken its present path if it had been a purely original consequent stream, I cannot agree with him when he endeavors to show that recourse must, *of necessity*, be had to the postulate of an antecedent origin; for it seems highly improbable that such a small river, whose upper drainage area is of so little extent, could have victoriously reinted the uplift of such great anticlinals as the Graitery, the Raimeux, the Roche and the Choindez folds are. The failure of other explanations to meet the facts, which is given by Mr. Foerste, together with the systematic arrangement of several series of *cluses* in straight lines, as the main support of the theory of an antecedent origin (loc. cit., p. 411), does not seem to constitute a valid argument: are we absolutely certain not to have overlooked some possibility, which could turn out, when followed out in detail, to involve the true explanation?

But, apart from these considerations, if such is really the origin of the *Cirques* followed by the Birse, we should expect to find in the Jura Mountains many other examples of the same absence of relation between river-courses and constructional form. In order to test in a definite manner the validity of Mr. Foerste's conclusions, and to see whether his theory may be of general application in the Jura or not, my friend, Col. de la Noë, has lately drawn, at my request, a large map of the whole country between Bâle, on the Rhine, and Belley, near the Rhone, a map upon which all the heights have been referred to a common datum plane (in a stratigraphical sense), viz.: the limit between the uppermost Jurassic beds and the base of the Cretaceous (Neocomien); as a basis for the work, use was made of the sheets of the new map of France, drawn in contours with 20 metres vertical interval on the scale of 1:200,000, geological boundaries being adjusted on the same from the detailed maps of the French and Swiss Surveys. The altitude reached at any point by the horizon selected, above the present surface, if denuded, or underground, if covered by more recent deposits, could be computed with a fair degree of approximation, thanks to the numerous measurements of sections published during the last decade for various parts of the Jura; contours were then constructed, every 100 metres apart, without any regard to the present topography, and a photographic proof of the map, reduced one-half, colored in the manner of an ordinary hypsometric map.[1]

The result is very striking: nearly everywhere a strict accordance is shown to exist between the actual courses of rivers and the distribution of the lowest parts of the constructional surface; the larger streams, those which might be expected to exhibit the most irregular courses if the assumption of an antecedent origin was correct, are precisely those which follow the most closely synclinal depressions, making use here and there of *cols* where anticlinal arches are locally lowered in a transverse direction. Such is the case for the river Ain, the longest among the tributaries which the Rhone receives from the Jura, and for the Doubs, the longest stream in the whole region. A beautiful illustration of a series of *cluses* arranged in a straight line, and demonstrably correlated with the lowering of several adjacent anticlines from both sides, is given by the river Bienne, between the town of St. Claude and its junction with the Ain. Many other cases might be pointed out to the same effect, viz.: that the Jura drainage, as a whole, is typically consequent upon the deformations, and that, accordingly, Professor Davis was quite right in postulating as the initial stage, in the development of Pennsylvania rivers, essentially original courses during Permian time.

As to the special case of the Birse, no doubt that apparent exception remains to be explained; that backward erosion may have been concerned in the production of the Bernese *Cirques*, Mr. Foerste himself seems to concede, in alluding to the Crémine cirque; and I believe nobody can have seen the Soulce depression, on the outside of the Choindez fold, or the great ravine south of Châtillon, a little more to the east, without being struck by the analogy of both features with an unperfected *cluse*—and their purely regressive origin is beyond question.

A last word about the crystalline pebbles in the Tertiaries of the Bernese Jura: Mr. Foerste, following J. B. Greppin, believes that they came from the Schwartzwald, to the north of the district. But that conclusion is far from certain. Dr. Rollier, who has carefully surveyed the district on the scale of 1:25,000,

[1]The method here described does not seem to have been, as yet, appreciated to its full value. Originated, I believe, in America, with Professor Lesley's efforts, and splendidly applied to the study of the anthracite fields of Pennsylvania by his lamented assistant, the late Charles A. Ashburner, it has been but little resorted to, outside of very limited districts and for purely scientific purposes. So far as I am aware, the only similar attempts yet made to construct in contour-lines stereograms of displacements, for a broad geographical area, are Mr. Doll us's "Carte hypsometrique de la Surface de la Craie dans le Bassin de Paris," on the scale of 1:1,000,000, published in Bulletin No. 14 of the French Geological Survey (Paris, 1890), and the two maps illustrating the shape of the Trenton limestone in Ohio and Indiana, publi hed by Professor Orton and Mr. Phinney in the Eighth and Eleventh Annual Reports of the United States Geological Survey, respectively. I myself constructed, several years ago, a contour map, still unpublished, showing the deformations of the Dakota sandstone in western Colorado (from Hayden's atlas of that state), and where the same agreement between structure and hydrography as is here advocated for the Jura was plainly exhibited. The construction of such maps would be specially fitting in those countries where detailed geological surveys are conducted upon topographical maps in contours as a basis, such as are in most parts of Germany.

when conducting five years ago the Swiss Geological Society on the ground, expressed the opinion, then endorsed by Professor Gutzwiller and Professor Baltzer, that the pebbles, at least in part, came, on the contrary, from the south and were of Alpine origin;[2] and it may be well to recall that such was also Studer's opinion.[3] It would make the case very different, in so far as several of the paleo-geographical conclusions of Mr. Foerste are concerned.

INDIANA ACADEMY OF SCIENCE.

THE ninth annual meeting of the Indiana Academy of Science was held in the capitol at Indianapolis, Dec. 27 and 28, 1893, under the presidency of Dr. J. C. Arthur, of Purdue University. The morning of Wednesday was devoted to a discussion of the proposed biological survey of Indiana. The directors having the survey in charge first presented reports of their respective divisions. Dr. L. M. Underwood, Division of Botany; Dr. C. H. Eigenmann, Division of Zoölogy; Prof. V. F. Marsters, Division of Palæontology. For some time there has been under discussion a plan for several states to coöperate in the work of such a survey; This matter was taken up, and Dr. J. M. Coulter, of Lake Forest, Ill., spoke for that state. Prof. R. E. Call represented Kentucky. Several of the workers on the Indiana Survey spoke on various phases of the work. "Phænerogams," discussed by Prof. Stanley Coulter; "Fishes," Dr. C. H. Eigenmann; "Plans for Successful Work," Dr. J. M. Coulter; "What Can the High Schools Do to Help the Survey?" Prof. W. S. Blatchley. "Can the Common Schools Aid?" Prof. W. W. Norman; "Mollusks," Prof. R. E. Call; "Palæontology," Prof. V. F. Marsters; "Ornithology," A. W. Butler. The discussion occupied the full half-day.

In the afternoon the Academy met in two sections, one devoted to botany and zoölogy, the other to chemistry, physics and mathematics. In the former the following papers were presented: "An Alphabetical and Synonymical Catalogue of the Acrididæ of the United States," W. S. Blatchley; "On the Hibernation of Turtles," A. W. Butler; "Some Notes on a Variety of *Solanum Dulcamara*," R. Wes. McBride; "Indiana Fishes," C. H. Eigenmann; "Review of Botanical Work in Indiana with Bibliography," L. M. Underwood; "Notes on an Imbedding Material," John S. Wright; "Recent Notes on Indiana Birds," A. W. Butler; "The Distribution of Indiana Birds," A. W. Butler; "On the Occurrence of the Rarest of the Warblers (Dendroica Kirtlandi) in Indiana," A. B. Ulrey; "Histology of the Pontederiaceæ," E. W. Olive; "Growth in Length and Thickness of the Petiole of *Richardia*," Katherine E. Golden; "The Geographical and Hypsometrical Distribution of North American Viviparidæ," R. Ellsworth Call; "Recent Notes on Cacti," J. M. Coulter; "The Field Columbian Museum," J. M. Coulter.

In the physico-chemical section were presented: "Estimation of Organic Matter in Water by the Potassium Permanganate Method," Thos. C. Van Nuys and Sherman Davis; "1. 4. Di-amino-cyclo-hexane," W. A. Noyes and H. H. Ballard; "Preliminary Note on Variations of Strength of Timber in Different Parts of the Cross Section of the Tree," Thomas Gray; "A Method of Determining Traces of Cyanogen in Organic Matter," Sherman Davis; "Integration of a Linear Vector Differential Equation," A. S. Hathaway; "An Autographic Method of Testing the Magnetic Qualities of Iron," Thomas Gray; "A Case of Stereo-isomerism in the Hydrazones of Benzoin," Alexander Smith; "Camphoric Acid," W. A. Noyes; "The Value of the Steam Pipe within the Smoke Box of a Locomotive, as a Means of Superheating," Wm. F. M. Goss; "An Experimental Study of the Action of the Counterbalance in Locomotive Drive-Wheels," Wm. F. M. Goss; "Methods of Starch Determination," W. E. Stone and D. B. Hoffman; "The Combustion Gases of the Locomotive," W. E. Stone.

Wednesday evening the Academy met in general session. The following officers were elected for the ensuing year: President, W. A. Noyes, Terre Haute; Vice President, A. W. Butler, Brookville; Secretary, C. A. Waldo, Greencastle; Assistant Secretary, W. W. Norman, Greencastle; Treasurer, W. P. Shannon, Greensburg. President Arthur then addressed the Academy on "The Special Senses of Plants."

Thursday morning the early part of the session was devoted to the reports of committees. A change was made in the constitution of the Academy providing for a body of fellows. The following papers were then presented: "Should the Study of Natural Science in the Lower Classes of the Public Schools be Encouraged?" W. W. Norman; "The Detection of Strychnine in an Exhumed Human Body," W. A. Noyes; "Absorption of Poisons by Animal Tissue After Death," P. S. Baker; "The Application of Graphical Methods to the Solution of Some Problems in Electrical Engineering," Harold B. Smith; "Induration of Certain Tertiary Rocks in Northeastern Arkansas," R. Ellsworth Call; "The Effect of Environment on the Mass of Local Species," C. H. Eigenmann.

At the afternoon session the following papers were offered: "The White Clays of Southern Indiana," A. W. Butler; "The Ash of Trees," Mason B. Thomas; "Poisonous Influence of *Cypripedium spectabile*," D. T. MacDougal; "Notes on the Biological Survey," Mason B. Thomas; "Notes on Sectioning Woody Tissues," John S. Wright; "The Stomates of Cycas," Mason B. Thomas; "Symbiosis in Isopyrum Biternatum," D. T. MacDougal; "Our Present Knowledge of the Distribution of Pteridophytes in Indiana," Lucien M. Underwood; "Concerning the Effect of Glycerine on Plants," John S. Wright; "The Adventitious Plants of Fayette County," Robert Hessler; "Bibliography of Indiana Ornithology," A. W. Butler; "Bibliography of the Batrachians and Reptiles of Indiana," O. P. Hay; "Bibliography of Indiana Mammals," A. W. Butler and B. W. Everman; "The Effect of Light on the Germinating Spores of Marine Algæ," Melvin A. Brannon; "Notes on Saprolegnia," George L. Roberts; "Contributions to the Life-History of Notothylas," D. M. Mottier; "Some South American *Characinidæ*, with Six New Species," A. B. Ulrey.

The Academy decided to hold its next meeting in May at Rochester, Indiana, where, in connection with the meeting, an exploration of some of the beautiful lakes in that vicinity can be undertaken.

—Diana Clifford Kimber will soon publish a text-book on "Anatomy and Physiology for Nurses," in connection with Louise Darche. Miss Kimber's experience as assistant superintendent in both the New York City and the Illinois Training School for Nurses has led her to feel the need of such a manual and to undertake the work. It is designed to fill a middle place between the text-book written for medical students and that for use of children in schools. The subject is presented in a scientific manner, but the technicalities which discourage the average student have been, so far as possible, avoided.

[2]See Eclogæ Geologicæ Helvetiæ, 1888, No. III., p. 281.
[3]See L. Rollier, Etude stratigraphique sur les terraine tertiaire du Jura Bernois (Archives des Sc. Phys. et. Nat., March, 1892).

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

THE CRUISE OF THE CLOVER—FURTHER REMARKS ON THE ABERRATIONS OF AUDIBILITY OF FOG SIGNALS—THE METHODS USED.[1]

BY ARNOLD BURGES JOHNSON, WASHINGTON, D. C.

IT is now about a quarter of a century since Prof. Joseph Henry, the first President of this society, commenced his investigation into the operations of the laws of sound in connection with the fog signals used by the Light House Board, of which board he was then the scientific member.

When I was made Chief Clerk of the Light House Board in 1869 it became my duty, as well as a privilege which I highly prized, to act to a certain extent as his amanuensis and aid in putting the results of his experiments in the form of reports to the Light House Board. In this way I became interested in this work and was, in a very humble way, associated with Professor Henry in its prosecution. Thus I entered with him into a practical discussion of the subject and became, after a fashion, possessed of his views as to the best way to follow up the investigation. I thus came to know something of his tentative plans and of his desire to make very practical use for light house purposes of the outcome of the investigations.

On Nov. 6, 1880, the great Long Island Sound steamer Rhode Island was stranded and finally lost on Bonnet Point in Narragansett Bay. Then, putting it roughly, a million in property was lost and thousands of lives were imperilled. The master and pilot of the steamer claimed that the fog-signal at Beaver Tail Point, about one and seven-eighths miles away, was not sounding at the time of the accident; and hence the casualty. The light keeper who was in charge of the fog-signal at the time, and who was in peril of losing his place, proved conclusively that at the time of the wreck the sound of the fog-signal was heard at Newport, five miles away, at Fort Adams, four and a quarter miles away in one direction, and at Narragansett Pier, four and a half miles away in another direction. The steamer people, who were in danger of forfeiting their licenses, came back with affidavits of many on board that they were anxiously listening for the fog-signal, and that it was not in operation, for they did not hear its sound.

Then the Light House Board took a hand in the matter. It had been shown by Professor Henry that, although a sound could be heard at a certain distance from its source, it might not be heard in the same direction, and at the same time, at a less distance. Could this be one of those cases? A naval officer in the service of the board, now ranking as a Commodore, was sent to the locality to find out. He had the fog-signal at Beaver Tail started, and cruised round it in a sail boat for some time, taking constant note of the intervals of the sound. He found, and reported to everybody's surprise, that not only did he fail to get the sound of the Beaver Tail fog-signal at Bonnet Point, one and seven-eighths miles away, where the Rhode Island was lost, but he failed to get it at other points even nearer to the fog-signal, while he heard it on the same day at different points farther away, and much farther away in a line with the nearer points where he could not hear it. This settled the question. The light keeper was relieved from the charge of failing to have the fog-signal in operation, and the steamer people were relieved from the charge of failing to act on the warning of the fog-signal, which was blowing, but which, while within earshot, they might not hear.

In 1881 the great propeller Galatea, while on the way from New York to Providence, ran onto Little Gull Island in Long Island Sound, imperilling many lives and much property. There was, and is, on that island, which is but one-eighth of a mile long, a powerful light and a powerful fog-signal. That fog signal has been often heard sixteen miles away. The defense of the steamer people was that the fog was dense and that the fog-signal was not blowing. The light-keeper, in his defense, showed that the fog-signal was blowing, that it was heard and noted at several different points in different directions, say at New London, Mystic, and at several light houses, many miles away, at the very time the Galatea ran on the little islet on which the fog-signal was at work. Again the Light House Board was required to look into the matter. Again careful investigation was made. And again it was shown that the fog-signal might be heard far off, and not close to, and the spots where it was not heard were noted and plotted on the chart; and again the steamer people and the light house people were exonerated from blame.

In 1881 I gathered these facts and submitted them to the Philosophical Society. My paper was printed in the Bulletin of the Society, and it was largely copied in maritime and scientific publications in this and other countries. The light house establishments of England, France and Spain reprinted the paper, each in its own language. And the eminent Emile Allard, head of the French light house establishment and a prominent officer of the French Corps of Engineers, plotted my numerical statement of the intensity of sound as heard from the fog-signals, in graphic form, that is, in lines of various width, and sent his diagrams to me in a letter in which he discussed the subject at length.

The Light House Board meantime was considering the matter from a purely practical standpoint. If, it was reasoned, there is a point within earshot of a fog-signal, where, from any cause, the fog-signal cannot be heard, then some other signal should be placed at that point, from which vessels can take a fresh departure. Acting upon that idea, investigation was made as to the region about each prominent fog-signal which it had been said could not be heard at points where it ought to be heard. In several instances I was sent to such points to make investigation and to report with recommendations. In the summer of 1885 I cruised about Point Judith, R. I., and the southeast end of Block Island, both at the entrance of Long Island Sound, and about the light house and fog-signal on Little Brewster Island, entrance to Boston Harbor. An area of silence was found and plotted about one and a quarter miles south of Point Judith, where the

[1] Read before the Philosophical Society of Washington, Nov. 25, 1893.

powerful fog-signal in operation at Point Judith could not be heard. That area was soon marked by a whistling buoy. A similar area was found and plotted five miles from Block Island, and a whistling buoy was placed in the centre of that silent spot.

A curious state of things was found off the light house on Little Brewster Island, Boston Harbor. Complaint had been made as to the action of the fog-signal there, which was a Daboll trumpet, and another and better fog-signal was wanted. Some asked for a siren, some for a steam whistle, and some for a larger and better Daboll. So a battery of fog-signals, one of each kind, was placed there, and I was appointed, with others, on an informal sort of a board to ascertain and report which of the three was best adapted to the place. It was found that the siren gave the best effect, and it was duly established there, and is there yet. But it was also found that there were several areas of silence within normal ear-shot of that fog-signal which were constant as to their general position, but which were floating or variable in their actual positions. There were already so many lights, buoys, spindles, etc., in that vicinity it was recommended that no more be established there lest it cause confusion. It was deemed the most curious concatenation of peculiar phenomena yet met.

In observing all these peculiar phases of non-audition of fog-signals at points where they should be heard, only one vessel had been used at a time. Hence, we had no record as to the sound at more than one place at a time, of a fog-signal. It had been a favorite plan of Professor Henry to use several vessels simultaneously about the same fog-signal, so as to learn where its sound was heard, as well as where it was not heard, at the same moment. The board decided to follow that plan this fall and in this way to re examine, with several vessels at the same time, the sound of the fog signal, which had heretofore been examined with but one vessel at a time.

This duty was devolved on me, and I was ordered to the Clover, a fast-sailing schooner, to carry it into effect. I was permitted to invite two members of this society, Prof. C. A. White, LL. D., Member National Academy of Sciences, and Prof. H. A. Hazen, Forecaster of the Weather Bureau, to go with me on this cruise, and the invitation was afterwards formally repeated by the board. It was planned that when I had reached a scene of operation and a proper day was found, I was to impress any other light house vessel within reach for that day, and the light house district officers were directed to give every practical aid to the expedition. This they did with great readiness and good effect.

Thus it has happened that observations have been made recently from three vessels simultaneously, at three different places, of the sound of a number of fog-signals at which abnormal phenomena had been observed and reported before; and the recent observations have been made, and have been plotted on the same scale as previous observations; so that all the observations made at each place whether in 1881, 1885 or 1893 are now comparable.

The methods used at Little Gull light house and fog-signal station, for instance, were as follows:

The Clover arrived at New London Harbor on the morning of Oct. 19. Leaving her trying to work up to the city, against a headwind, I went ahead in the steam launch. At the light house depot I found the light house steamer, Cactus, with banked fires. In half an hour she was under way, and towing the Clover toward Little Gull light station. Dr. White, Professor Hazen and I went on shore and the light keeper was directed to start up his fog-signal. Dr. White remained on the islet to see that the orders were carried out and to note any variations made from any cause in the usual sound. Then Professor Hazen went on board of the Clover and I returned to the Cactus, and each vessel ran over prescribed courses. Observations of the intensity of the sound were made on each vessel each minute. The direction and force of the wind, the temperature by wet and dry bulb thermometer, and the pressure of the atmosphere, as shown by the barometer, were duly recorded. The appearance of the sea and the sky were also noted.

The next day the Cactus was engaged on other imperative duty and the Clover went out from New London Harbor, where we had spent the night, without her. But Professor Hazen made a rather adventurous cruise in an open steam launch about the fog-signal, with excellent results.

On the third day Professor Hazen was on the schooner Clover, and I was on the steamer Cactus. Dr. White was landed on Great Gull Island, which is small, treeless, and uninhabited, where he had large opportunity, which he fully used, to get the sound of the fog-signal under circumstances not had before. Here Dr. White noted the action and the result of peculiar echoes, and his studies of these echoes have developed an important factor in the discussion.

Off Point Judith we had very light wind, almost no sea, though there was a heavy swell rolling in, and a fair sky; in other words, we had an excellent day for hearing.

The Cactus being again with us, I went on her, Dr. White stayed with the Clover, and Professor Hazen, in spite of the bad character of that vicinity for quick and severe changes of weather, again took to the steam launch; so we got simultaneous observations of the sound of the fog-signal at Point Judith from three vessels, each cruising about on different lines.

In our work about the light on Little Brewster Island, at the entrance to Boston Bay, which occupied two days, we had the help of two other steamers. Major Livermore, of the Corps of Engineers, U. S. A., and Engineer of the First and Second Light House Districts, went with us on his steam propeller, the Myrtle, and Lieutenant Commander Colby, U. S. N., assistant to the Inspector of the Second Light House District, accompanied us on the side-wheel steamer, Geranium. On the first day I was with Major Livermore on the Myrtle, Dr. White was in charge of the work on the Clover, and Professor Hazen went with Lieutenant Commander Colby on the Geranium. On the second day Dr. White went with Major Livermore; I stayed on the Clover, and Professor Hazen remained with Lieutenant Commander Colby on the Geranium. Each vessel ran on different courses on different days, and we got many simultaneous observations from the three vessels. Most of the time was spent on the open ocean between Boston light and Minot's Ledge light, or beyond, or between Boston light and Egg Rock light. Part of each day, as we were going and coming from Boston Harbor, was spent in the Narrows, or in Broad Sound, at the rear of the fog-signal we were observing.

Now, as to our tools. We had on the Clover an annometer at the foremast head, and another at the end of the jib-boom. Both were connected by electric two-conductor cables with self-registering apparatus in the cabin. We also had a barograph which registered the pressure of the atmosphere, and we had a very delicate barometer by which to check the barograph These had been lent to the expedition by the Weather Bureau, and were under the charge of Professor Hazen, who looked after our meteorology. In addition to these, the Professor had brought his own sling pschycometer, an ingenious arrangement of wet and dry bulb thermometers, which he managed with great skill, and clung to with much affection. The Clover had her own complement of thermometers, barometers, etc., in addition to what had come to us from the

Weather Bureau. The balloon which the Secretary of the Treasury had asked the Secretary of Agriculture to permit the Weather Bureau to lend us, and which had been shipped to us, did not arrive. Had it come we might have had Professor Hazen looking down upon us from a great height, and we should have had him at the end of a rope, recording temperature, air currents, moisture, wind and sound from 1,000 feet above, and at intervals of 25 feet, till we landed him on our deck or in the water. Major Livermore, however, used toy balloons, with which to ascertain the force and direction of the upper air currents. The paper balloons were, say, four feet high, and one foot in diameter, at the widest part. They had an ingenious attachment for producing hot air, which, at night, lighted them, and made them for a while clearly visible. The longest flight I saw one of these make was 15½ minutes. Then the Major had spherical rubber balloons of, say, nine inches through, which he filled with hydrogen generated on the Myrtle, which were also quite useful.

The fog-signals we were sent to observe were three steam sirens and a steam whistle. Each signal has its own peculiar characteristic. The second-class siren at Little Gull Island, for instance, gave, during a fog, a blast of five seconds, and then after a silent interval of 40 seconds, and another blast of five seconds, and it continued this alternation of blast and interval while the fog continued. This blast and interval served to differentiate this signal from other signals within ear-shot, and especially that at New London light-house, which was a six seconds blast, alternating with a silent interval of thirty seconds.

The siren is the most powerful fog-signal in existence. The English Government adopted it after a favorable report on it made by a commission sent to this country headed by Sir Frederick Arrow, and also after a report by Professor Tyndall, who then bore the same relation to the English lighthouse establishment that Professor Henry did to the United States lighthouse establishment, that is, of scientific adviser.

Tyndall says of the siren in his book on "Sound," third edition, p. 316: "The steam siren is the most powerful fog-signal which has been tried in England." Again Tyndall says on p. 318: "We find the sound range on clear calm days varying from 2 1/2 to 16 1/2 miles." Again he says on page 319: "It may be relied upon at a distance of two miles; in a great majority of cases it may be relied upon at a distance of three miles, and in a majority of cases at a distance greater than three miles."

Now as to the full range of the instrument, Tyndall says on page 321 of the same book: "The most conflicting results were at first obtained. On the 19th of May, 1873, the sound range was 3 1/3 miles; on the 20th it was 5 1/2 miles; on the 2nd of June, 6 miles; on the 3rd, more than 9 miles; on the 10th, 9 miles; on the 25th, 6 miles; on the 26th, 9¼ miles; on the 1st of July, 12¾ miles; on the 2nd, 4 miles; while on the 3rd, with a clear, calm atmosphere and smooth sea, it was less than 3 miles."

I have quoted this much from Tyndall, for while he accepts the siren, he damns it with faint praise, and what he says is about the worst that has been said of it. The French, who also adopted it, speak in much higher terms of it, and the Light House Board, while constantly searching, has found nothing better. It remains the best fog-signal in the world, and it may be regarded as a constant memorial of the work of Professor Henry, who, for lighthouse purposes, was its inventor.

But good as the siren is, it leaves much to be desired. It is a great big clumsy, ugly machine, expensive to make, expensive to run, and expensive to keep in repair. It is maintained to make a great big ugly noise continuously, and of a certain kind and at certain intervals. It makes the noise, without regard to ethics or esthetics; but it might keep its pitch better; and it might maintain its intervals better. It is not an instrument of precision. It has its limitations. They are not entirely unconnected with the pressure of its steam; in other words, with its management. But it approximates exactness sufficiently near to answer the purposes for which it is intended. When the mariner hears it, and hears it aright, he knows where he is. The question we are discussing is not so much connected with the sound made as with the sound heard. It is not the aberration of the sound, but the aberration of the audition of the sound with which we are concerned.

Now as to the method used to determine the intensity of the sounds of the fog-signal we tested. This we did, on this cruise, by ear, and on the same scale and in the same way in which it was done in observations made in 1881 and 1885.

Each of the party on the Clover used the scale of 10. It was understood that 10 was the sound of the highest intensity, and 0+ the lowest sound observable. We divided the scale, however, thus: 1 1 plus, 1½, 2 minus, and then 2. Mr. Wallace, Major Livermore's assistant, used the scale of 100. I have no doubt that is just as good as my scale, but as I had commenced my observations on the scale of 10, I carried that scale through these observations in order that those made in '93 might be comparable with those made in '85 and in '81. The question of personal equation has arisen, but I have carefully avoided any comparison of the mode of hearing, or rather accuracy of hearing, between members of my party. My direction to each was to record 10 as the highest sound of the fog-signal that could be heard on board of the vessel in which he was making observations. When they were as near as they could get the vessel to the source of sound, the distance was, as a rule, not more than one-fourth of a mile. The minimum sound was 0. plus. One-half of the sound between 0+ and 10, I considered as 5, and half-way between that and maximum was called 7½, and half-way between 5 and 0+ was regarded as 2½, and then we divided still finer between those points. In that way I think we got a practical solution of the question, and are as nearly accurate as it is practicable for observers to be, that is, for practical, but not for scientific, purposes.

Each person preserves his own scale throughout, recording the maximum and minimum and medium, and dividing between those points according to the accuracy of his own ear. I noticed that different members of my party, and of Major Livermore's party, did not mark instances the same under some circumstances; but the differences were slight, and they could be accounted for by interfering noises in different parts of the ship, which affected different hearers in those parts of the ship, so that their hearing of the same noise was to a certain extent interfered with. I think the results reached were of a practical character, although they were not such as might be considered severely, or even scientifically, accurate. They were not such as would have been recorded by a self-registering machine, that is, they were not as finely phrased. I tried to put myself in the place of the mariner, who might hear a fog-signal without knowing what it was, and who might be forced to determine its identity by the character of its blast, the intensity of its blast, and the continuation of the silent interval between blasts.

Major Livermore has a large number of observations which have been plotted, and I think will be comparable with ours when ours are plotted.

We are now having very delicate instruments made with which to measure the character and the intensity of the sounds made by fog-signals; and thus I hope that next year we may be able to give the intensity of the sounds heard, with an approach to absolute accuracy.

The results thus far obtained, however, are such as a captain of a vessel coming onto our coast in a fog and a gale would be apt to get. It is for him the fog-signals are established, and I have tried to put myself in his place and to hear with his tired and strained ears the sounds which must be distinguished and differentiated from the shrieking of the wind, the creaking of the cordage, the rattle of the machinery and the roar of the surf.

If he has heard aright the sound of the fog-signal and can tell from the length of its blast and the following interval of silence which one of the several fog-signals in that vicinity it is, he is certain of his position.

The experiments thus far made and the observations taken are to make sure that the mariner can hear aright what he does hear, and to provide against his acting upon errors in hearing, which, if acted on, may place his ship in peril.

SASSAFRAS TREES.

BY WALTER J. QUICK, COLUMBIA, MO.

As being of some scientific interest, it is worthy our attention to note the marvelous growth that ten trees of the above well-known variety have acquired here in Missouri—a growth that is so exceptional of this species that it has not been observed elsewhere in the United States.

The *Sassafras officinale*, of the order *Lauraceæ*, the Laurel family, is very seldom known as little more than a shrub or bush and generally as growing poorly or not at all on fertile soil. In truth, it is looked upon as being in its native element in company with and growing on thin land. This is not a fact, but the opinion prevails since old and worn-out fields, depleted of their fertility in greater part, when abandoned, grow up to "brush," not the least profuse of which is the sassafras. It is a native of America and has been found in every State in the Union, growing much more abundant on poverty-stricken soil, but more luxuriant and larger in proportion, we conclude, as the per cent of humus in the soil increases. In the poor, white clay lands of the New England States and some parts of Indiana, Kansas and this State we have observed it growing where it seems to sprout profusely and does not reach a height of over twelve feet, usually six or eight feet, while in the same States on richer land it will not be found in thick profusion, but scattered and attaining almost to the dignity of a tree in size.

Recently it was our pleasure to visit the beautiful farm of Mr. T. B. Hickman, near Columbia, Mo. During our stay we were shown the various interests of the owner, and our attention was summoned to some peculiar trees of the sassafras variety. Their difference from others of this species consists in their vigorous growth and extreme size, being the largest any one present had ever seen or of which we had in any way known. This preternatural development inspired us to investigation. They exhibited on measurement the surprising circumference of 80 to 82 inches—a diameter of over 26 inches. As the bark is thick and rough, similar to walnut, the diameter of the solid wood is not likely this much, but fully two feet. By triangulation we ascertained the height to be about fifty-five feet, and the whole ten will not vary much from these measurements.

While there is very little indication of decay, as a matter of fact, these trees are fully grown for this variety. Their location is very auspicious for the growth they have made, being the low, rich and moist soil of Bonne Famme creek bottom. The writer has never seen larger trees, and is unable to learn of larger specimens on this continent, with the exception of the species of sassafras of California and the western slope of the Rocky Mountains, known as *Oreodaphne Californica*, which attains a still larger size "in the land of big trees." The aroma from the leaves of this variety is more pungent, in fact, so much so as to occasion excessive sneezing, frequently during high winds. It has a greater reputation medicinally than ours, though the importance of the latter is by no means small.

Our *officinale* species has been introduced into England as *Sassafras laurus*. As is usual with anything imported, they appreciate it more as medicine than we do. A tree near the Royal Gardens at Kew has attained a height of about fifty feet, and is said to be over 110 years old. As there are no other figures given, we cannot compare the size with that of the Hickman trees, but the height is not so great.

Almost every country has one or more species of this tree, all said to differ in some characteristic from ours, but all having the same odor and similar aromatic, sweetish taste. But one country has larger trees. Those of New Zealand grow to a height of 100 to 150 feet. This tree appears in every clime, and is described as having "a large head of horizontal branches." The fruit is a small, black drupe, which is not palatable, but is eaten by birds. The sassafras oil of commerce is made from these seeds and the buds. The leaves of our species are very dark green, rather thick, broad, oblong and elliptical.

In Italy it is more like the American species than any other, and is known as *Sassafrasso*. The word comes from the Latin, *saxum*, a stone, and *frango*, I brake, so named because it was believed that the use of the tea made from it would desolve the gall stones of the bladder and prevent their formation.

In the southern states sassafras grows to the size of trees, generally small, but very abundant. The air is said to be more pregnant with its aroma than further north, and it can be detected a great distance at sea. The bark seems to be more fragrant, too, when steeped.

Sassafras tea is very popular in many sections of the countries where the tree grows. The bark of the roots is kept everywhere for sale, for that purpose. In addition to its use as a table beverage it is employed as a tonic and constitutional stimulant. In those localities where the sugar-maple tree is a native and abundant a very delightful drink is made from the "sugar-water," or sap and bark of the sassafras root. It makes the finest tea in the spring when the sap is forming and is then drunk mostly to resuscitate the system, improving the appetite and aiding the digestion. It is also valuable for boils, pimples and eruptions of all sorts, as well as for rheumatism.

The pith of the new growth and sprouts contains a gum or mucilage, used in eye medicines, as being important in reducing inflammation and granulations. This product is also prepared in the form of a drink for diseases of the kidneys, catarrhal troubles and dysentery.

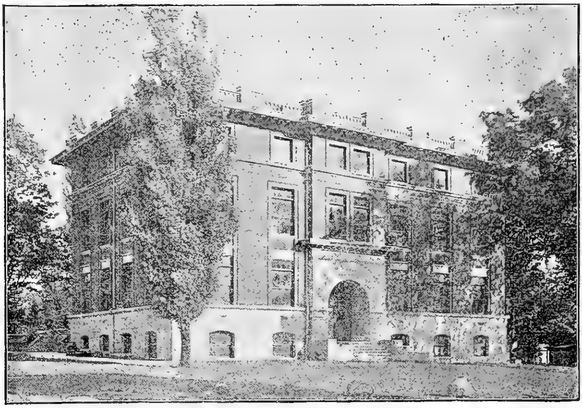
In many localities there is perhaps no more popular farmers' remedy for diseases of horses. It is administered by grinding the root bark to a powder and giving it in the feed, or by preparing a decoction with which the feed is mixed. Frequently the roots are placed in the horse's feed trough, and he is permitted to bark them himself, which he willingly does, apparently with much relish. In the spring it greatly improves his appetite, strengthens him and assists in shedding and sleeking his coat.

THE McMILLAN CHEMICAL LABORATORY.

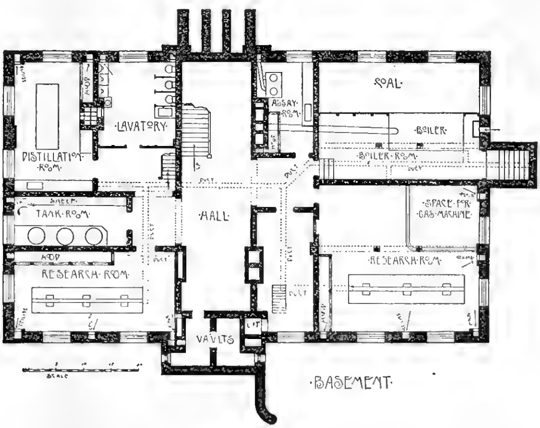
BY DELOS FALL, ALBION, MICH.

This building, the generous gift of Senator James McMillan, is now completed and will be devoted exclusively to the Department of Chemistry. It was dedicated Nov. 15 with appropriate exercises, addresses being delivered by Professor A. B. Prescott, of Michigan University, Professor H. H. Donaldson, of Chicago University, Senator McMillan, Professor Washington Gardner and others.

The plans were drawn by Mr. E. W. Arnold, architect, of Detroit; the building was erected by the firm of Wallace & Morris, builders and contractors, of Detroit.



The cut of the exterior and the floor plans here presented will give the reader a general idea of the structure. The general form of a building that would best suit the requirements of the various departments was found to be a rectangle, 52 × 88 feet. This is divided into two parts in each story by a hall 13 feet in width. This provides a wide, recessed entrance on both sides of the building.



BASEMENT.

There are three stories and a basement, all abundantly lighted by high and broad windows.

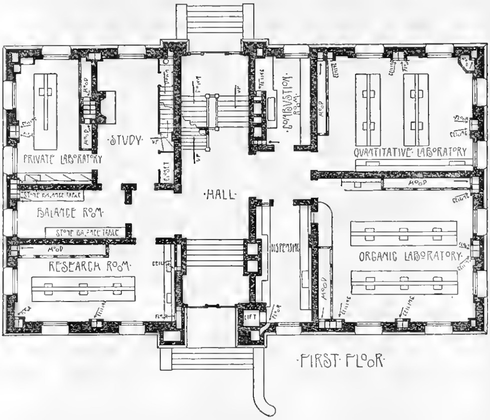
All outside and inside walls are of brick. The entrances, sills, lintels, copings, etc., are cut stone, the cornices of galvanized iron. The foundations are of stone. From the ground to the first story window-sill, the outside is faced with cut stone ashlar in courses.

The exterior treatment is colonial in character, which will give to the building a quiet dignity and, at the same time, perfect appropriateness to the purposes for which it is erected.

The basement story is 10 feet high and contains a boiler and fuel room, an assay laboratory with three furnaces and a fire table; a hall, a fire-proof storage vault; a research room, fitted with tables, ventilating hoods, etc.; a room for large gas tanks holding oxygen and hydrogen; a distilling room, with fire-proof tables, hoods, etc.; a lavatory, a storage room, and a second large research room.

In the first story, which is 13 feet high, there is, on one side of the hall, the organic laboratory, 27 × 30 feet, containing tables for 24 students, with 29 feet of hoods, also wall tables, cases for chemicals, etc. Adjacent to this is the quantitative laboratory, 22 × 30 feet, with tables for 20 students, hoods, wall tables, etc.; a combustion room, 10 × 17 feet, and dispensing room, 10 × 21 feet.

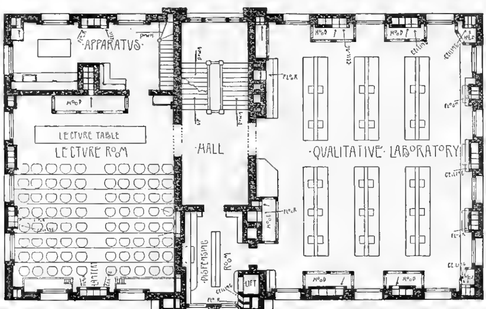
On the other side of the hall is the instructor's study with a private stairway to the basement and the lecture room above. This is furnished with book cases, fire place, wardrobe, etc. Off this is a private laboratory, with large table, hoods, wall tables, cases, etc. The balance room, 9 × 21 feet, and a research room, 15 × 30 feet, complete the equipment of this floor.



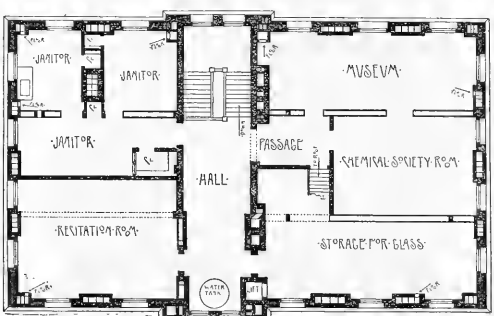
FIRST FLOOR

The second story is also 13 feet high and contains the qualitative laboratory, 40 × 49 feet, with tables for 80 students, with 7 hoods, wall tables, cases, etc. The lecture room, also on this floor, 30 × 37 feet, will accommodate 82 students, the seating being arranged in rising tiers of chairs. This room also contains an elaborately furnished lecture table, provided with a large pneumatic cistern, a powerful down draught for handling noxious gases, wash bowl, gas, water and waste pipes at convenient intervals, hydrogen and oxygen from the tanks below, electric connections with dispensing and assistant's rooms, a plunge battery, etc.

Behind the lecture table is a hood 14 feet long, double counter-balanced blackboards, a rolling stereopticon curtain, etc. Off the lecture room is an apparatus and preparation room, which will also contain cases for lecture table apparatus.



SECOND FLOOR



THIRD FLOOR

The third story is 10 feet high and contains a chemical museum, a class room, a chemical society room, three rooms for janitor's residence, store rooms, etc.

The heating is by steam, direct radiation, and in addition to this there are encased radiators recessed under the windows with register openings through the wall. By this means a supply of warm, fresh air is admitted to each room, which can be fully controlled.

The ventilation is by large ventilating flues and groups of flues arranged so as to ventilate all parts of the building and at points where most needed. The flues are in three sets, viz.: for floor ventilation, for ceiling ventilation and for hood ventilation, each set independent of the other and yet each working in combination with the other, and all controlled independently. Steam heat is applied in all flues in the upper story, which will insure their proper working.

The Laboratory is supplied with gasoline gas from a machine of 400 Bunsen burner capacity. Each student's table is provided with two gas and two water cocks, wash bowl, two drawers, cupboards and shelves. The gas and water are also distributed to all hoods, dispensing rooms, etc.

THE GRADUAL DISAPPEARANCE OF THE RANGE GRASSES OF THE WEST.

BY I. W. TOURNEY, TUCSON, ARIZ.

In the early days of our great West almost the only method of travel from the Mississippi Valley to our western coast and intervening points was by caravan. Wagons drawn by horses or cattle were several months in making this journey. During this time the stock subsisted entirely upon the natural forage afforded by the country traversed. For the most part, this forage was perennial grasses, which at that time were everywhere abundant. Then the whole of the West was a great pasture, unstocked, save for the herds of buffalo, deer and antelope. Many regions which were covered with a luxuriant growth of nutritious grasses are now entirely destitute of vegetation, if we exclude a few straggling, stunted bushes and the yearly crop of annuals which follow the summer rains. As a more specific case, the rancher who drove the first herd of cattle into Tonto Basin, in central Arizona, found a well-watered valley, everywhere covered with grass reaching to his horse's belly. In passing through this region a year ago scarcely a culm of grass was to be seen from one end of the valley to the other. This transformation has taken place in a half-score of years.

The important native forage grasses are perennials, many of them of the great western genus *Bouteloua*. Their growth in all parts of arid and semi-arid regions is slow. The grasses which formerly covered so great an area of our West were years in developing their root systems, and, in not a few species, even the culms were of several years' growth. When only cropped by the deer and buffalo they were able to hold their own against the drought and other agencies of nature. By stocking this great western country with the herds of civilization, these grasses were mowed down before them like timber before the forest fire. They are gradually becoming less and less, and it is only a question of a few years when, in many regions, they will disappear as a material factor in the natural forage of the country. Regions long distances from water, out of reach of the great herds of cattle everywhere on the un-fenced domain of each western state and territory, are yet well-covered with perennial grasses. Last year in passing over a large unwatered area north of Prescott miles of country were found covered with grass, while in much more favored localities in the vicinity of water these species have entirely disappeared.

Cattle men are putting down wells in many of the unwatered regions and moving their herds thither. The first year the forage is excellent, the next year it is not so good, and the third or fourth year it becomes so poor that the well is abandoned and another sunk in an as yet unfed locality. The more arid the region the more disastrous is the effect of overstocking. When stock are driven into a locality they are allowed to increase, not in proportion to the amount of forage that the given range is in condition to furnish year after year, but as many are grazed as can find feed for the time being. No consideration or thought is expended on the future. This condition of things has been most disastrous to stock-men throughout the West. To within a few years the efforts of cattle-men were expended in increasing the size of their herds, and this continued until nearly every vestige of the perennial grasses was swept away. Since that time cattle have died by thousands, the assigned cause in most cases being cold weather or drought, when in reality it has been the lack of forage; the direct result of stocking the range to a greater extent than the natural conditions year after year will justify.

Many are deceiving themselves in thinking that a few rainy seasons will bring back the rich perennial grasses of the years gone by. It seems to me, under the present condition, the time can never come when our western range will be as rich in forage as it was ten or more years ago. Under the most favorable conditions, with cattle entirely excluded, it would take many years for these grasses to get the foothold that they formerly held.

The annual grasses, mostly the smaller *Boutelouas* and *Aristidas,* are not so disastrously affected by overstocking. They seem to be always on hand to cover the plains with verdure after the rainy seasons. They furnish excellent forage during the short period that they are at their prime, but at the most they can only provide feed for three or four months of the year. The ranchman makes a marked distinction between the annual and perennial grasses. He aptly designates the annual as "seed grasses" and the perennial as "root grasses." The seed grasses soon become worthless, their bleached, short culms are broken and beaten into the sand by storm and wind. The root grasses retain their vitality and remain green for the greater portion of the year. Even when dry, their harder, stronger and larger culms contain as much nutrition as well-cured hay, and are, or rather used to be, the valuable winter forage of the West.

In conclusion, there is a limit beyond which no range can be profitably stocked. If we exceed this limit it will not only be detrimental to the permanency of the range, but in the end will be disastrous to the stock as well. It is but natural that a growth of top is necessary to a growth of root, therefore if the tops be continually cropped to the ground, the roots will finally perish. This is especially true of grasses of arid regions, growing in bunches or scattered about here and there a few culms in a place. The range is frequently fed so close that few of the better grasses mature seeds, while many others are tramped out by horses and cattle. During the past few years the effect of over-stocking has shown itself in the inferiority of the cattle when compared with those of former years. They are poorer as a consequence of their increased number and the resulting deterioration of the range.

—The essays received by the Canadian Institute in the competition for a prize for the best act "which, if made law, would give the whole Canadian people equal representation in Parliament," have been issued to the final tribunal of judges. Their reports are returnable on March 15 next; immediately thereafter the awards will be announced.

MEETING OF THE IOWA ACADEMY OF SCIENCES.

The eighth annual session of the Iowa Academy of Sciences occurred in Des Moines, Iowa, Dec. 26 and 27, 1893, and was one of the most largely attended and profitable in the history of the Academy. About thirty Fellows were in attendance, and over forty papers were presented.

The officers elected for the coming year were: Dr. L. W. Andrews, President; Prof. H. W. Norris and Dr. C. R. Keyes, Vice-Presidents; Herbert Osborn, Secretary-Treasurer; and Professors Arey, Hendrixson and Nutting additional members of the executive committee. Dr. L. W. Andrews presented a paper on the "Assumption of a Special Nacent State," in which he concluded that the assumption of such a condition is the survival of an obsolete doctrine and that it explains nothing which cannot be as well explained without it. In another paper he treated of some peculiarities of Ferric Sulphocyanate, discussing them from a physico-chemical basis.

Prof. A. A. Bennett made a verbal report upon certain work done in the Chemical Laboratory of the Iowa Agricultural College and called attention to the methods in vogue in instruction in chemistry.

Prof. W. S. Hendrixson, of Grinnell, Iowa, discussed "The Electrolysis of Silver," detailing a method by which pure silver could be obtained in a rapid and easy way, and, in another paper entitled "Some Laboratory Apparatus," he described several inexpensive forms, one of which was for the distillation of water.

Prof. G. W. Bissell presented some notes on experimental engineering at the Iowa Agricultural College, giving the results of some studies, the result of which can be used to advantage in the designing of certain kinds of machinery.

Prof. S. Calvin, of Iowa City, discussed the "Geological Position of Benettites Dacotensis, MacBride," with observations on the stratigrophy of the region in which the species was discovered. This was a careful description of the geological features of the region of Hot Springs, South Dakota, with the conclusion that this fossil belongs to the Cretaceous.

Dr. C. R. Keyes read a paper upon the "Derivation of the Unione Fauna of the Northwest." He compared the faunæ of different river basins and discussed at length their relations and derivations. In discussing the paper Professor Shimek, of Iowa City, called attention to the similarity of the Unione Fauna of eastern Nebraska and eastern Iowa, whereas in central and western Iowa these forms are much less plentiful.

Prof. J. L. Tilton, of Indianola, discussed the "Origin of the Present Drainage System of Warren County." The present river valleys aud larger ravines fit into the preglacial valleys, whiie in the smaller divisions only do we find erosion without regard to the pre-glacial configuration of the country.

H. F. Bain, of the Geological Survey, in a paper on "The Structure of the Mystic Coal Basin," presented data from a number of different sections, showing a remarkable persistence of character in the coal strata at different points, which has had a very important bearing upon the development of the coal industry of southern Iowa. In another paper he gave a careful record of the strata penetrated in the boring of the "Deep Well at Sigourney." These borings of nearly two thousand feet penetrated the various formations to the "St. Peters" and entered the Oneota.

E. H. Lonsdale, of the Geological Survey, in a paper entitled "Southern Extension of the Cretaceous in Iowa," presented the results of an extended examination of the southwestern portion of the State, in which he has been able to determine the occurrence of Cretaceous deposits at points considerably farther south than hitherto recognized.

A. G. Leonard, on the "Zinc Deposits of Northeastern Iowa," showed that these deposits have proven quite valuable and are being extensively worked, occupying the same localities as the lead deposits, which at one time were worked with profit, but have for a number of years been practically abandoned. He also spoke of "Satin Spar from Dubuque, Iowa," and exhibited some very handsome specimens of this mineral.

H. A. Jones, of Grinnell, Iowa, in a paper on the "Coal Measures in Powesheik County," indicated the location of coal seams and coal measure strata in the vicinity of Grinnell and at other points in the same county.

Prof. T. H. McBride, of Iowa City, presented some very interesting "Notes on North America Cycads," in which he described the occurrence of a remarkable new species of Benetites found in South Dakota. He also showed photographs of a large specimen of the fossil and a specimen of one of the living species for comparison. In another paper he discussed the "Distribution of *Rhus typhina*."

The presidential address by Prof. L H. Pammell was devoted to a discussion of bacteria, their relation to modern medicine, the arts and industries. It was a very comprehensive and interesting account of the historical development of bacteriology and of the relations which these organisms bear to modern medicine and to various important industries. He also presented the following papers: "The Powdery Mildew of the Apple," "Further Notes on *Cladosporium carpophilum*" and "Notes from the Botanical Laboratory of the Iowa Agricultural College."

Prof. H. W. Norris, of Grinnell, in a paper on the "Development of the Ear of Necturus," presented the results of a very careful study of this organ and exhibited drawings of sections and also, for comparison, reconstructions of the ear of *Amblystoma*.

Prof. B. Shimek, of Iowa City, in "An Additional List of Iowa Molusca," recorded a considerable number of species additional to the list which he published some years ago. He also presented a paper and exhibited specimens illustrating the variations in certain Succinidæ occurring in the *loess*, comparing them with living forms and showing conclusively the great range of variation in certain species. He considers these shells an important factor in determining the age of the *loess* formations.

Prof. C. C. Nutting, of Iowa City, gave two anatomical papers, one devoted to the "Vascular Supply of the Teeth of the Domestic Cat," in which he showed that the distribution of the blood vessels to the teeth was different from what has been commonly held; the other discussed the "Homology of the Inca Bone."

Mr. Herbert Osborn, of Ames, presented a paper upon the "Distribution of Hemiptera," giving records which extend the known distribution of a number of species, also a paper including laboratory notes, in which he called attention to species particularly useful for laboratory work in this region.

Mr. C. W. Mally, in the "Hackberry Psyllidæ of Iowa," reviewed the species occurring in the state and gave very full descriptions of certain forms which had been studied in detail in their different stages.

Mr. F. A. Sirrine described "A New Species of Plant Louse Occurring on Thorn."

Aside from these papers, which were read, a number of others were read by title and will appear in the proceedings of the Academy, which will be published by the State at an early date.

Resolutions were passed commending the Geological Survey and, also, looking toward the securing of a greater amount of scientific literature in the State Library.

BALTIMORE MEETING OF THE AMERICAN CHEMICAL SOCIETY.

BY CHARLES PLATT.

After a rather dark period in its history, the American Chemical Society has now attained a firm footing, and has become what it has ever aimed to be, a truly national representation of American chemists. The summer meeting in Chicago and the recent Baltimore meeting have been extraordinarily successful, not only in papers presented, which are, after all, very secondary attractions, but more particularly in the establishment of those feelings of good fellowship and esteem which can only be born of personal acquaintance. During the last meeting this sentiment was expressed many times, and there was a universal feeling of congratulation and good-will, which made the meeting extremely satisfactory. The general verdict seemed to be that the time allotted was too short, and that a programme extending over three or four days, instead of the two provided by custom, would have been more suitable. The meeting convened Dec. 27, 1893, in the lecture-room of the chemical department of Johns Hopkins University, with President H. W. Wiley in the chair. President D. C. Gilman welcomed the society to the University, and Prof. Ira Remsen performed the same office in behalf of the chemical department. In response, President Wiley returned thanks for the society for the welcome so kindly extended, and, continuing, spoke of the remarkable growth of the society during the past year, its field in America, and the increasing need of such a bond of union as is provided. Professor Wiley then opened the business of the meeting with his presidential address on "The Relations of Agricultural Chemistry to the Waste and Recovery of Plant Food." Other papers on the programme, read in person or by title, were as follows: "The Widespread Occurrence of Barium and Strontium in Silicate Rocks," W. F. Hillebrand; "The Estimate of Small Amounts of Barium and Strontium in Silicate Analysis," W. F. Hillebrand; "A Plea for Greater Completeness in Chemical Rock Analysis," W. F. Hillebrand; "A Study of the Distribution of the Oleoresins in the 'Pinus Palustris,'" Omar Carr; "Salicylic Acid in Food," K. P. McElroy; "Utilization or Garbage," Bruno Terne; "Report on the Determination of Atomic Weights Published during 1893," F. W. Clarke; "The Detection of Strychnine in an Exhumed Human Body," W. D. Noyes; "The Importance of the Study of Biochemistry," E. A. de Schweinitz; "Upon Uniformity in Sampling and Assaying Copper Bullion," G. W. Lehmann; "The Preservation and Arrangement of Chemical Abstracts," Thomas M. Chatard; "Notes on the Electro-Metallurgy of Zinc," Charles Platt; "The Phenyl-hydrazen Test for Glucose in Urine," C. E. Pellew; "Expert Testimony," W. P. Mason; "A Description of the Boric Acid Springs in Tuscany," W. P. Mason; "Phosphorus in Steel," C. B. Dudley; "Determination of Phosphorus by the Molybdate Method in the Presence of Arsenic in Iron, Steel and Ores," J. O. Handy; "The Analysis of Malt," J. A. Miller.

Other papers not on the programme were presented, among them one by Dr. Thomas Taylor, of Washington, and another by Prof. G. F. Baker, of Philadelphia, who read a memorial to the late T. Sterry Hunt.

In the afternoon the society accepted the invitation of the Baltimore Copper Smelting and Rolling Company, and several profitable hours were spent examining the details of refining at these representative works. A complimentary banquet was enjoyed at the Eutaw House in the evening. On the second day the reading of the papers was continued and the annual business of the society transacted. The officers elected for the ensuing year are: President, H. W. Wiley; General Secretary, Albert C. Hale; Treasurer, C. F. McKenna (resigned); Librarian, F. E. Dodge; Directors—C. F. Chandler, P. T. Austen, C. A. Doremus, H. C. Bolton; Council—C. B. Dudley, C. E. Munroe, Wm. McMurtrie, J. H. Appleton. The meeting was brought to a close with a delightful excursion down the river to Sparrows Point, where the works of the Maryland Steel Company were thoroughly inspected.

LETTERS TO THE EDITOR.

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

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

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

Do Earth Worms Rain Down?

The old-time notion that earth worms, frogs, fish, etc., "rain down" is now seldom mentioned by intelligent people except in the way of ridicule. The sudden appearance of these animals after a shower is, however, a matter of common observation, and I am not aware that any adequate explanation of the phenomenon has ever been given.

I have heretofore mentioned the finding of minnows after a heavy rain in pools and ditches which were dry not long before. As for earth worms, their nature and habits seem to preclude their coming to the surface voluntarily. When dug up and left on top of the ground they seem very uncomfortable and lose no time in burying themselves again, as soon as they can find a spot where the earth is soft enough to penetrate. Of those found after a rain, some are dead, others nearly so, and those which are in motion seem plainly to be seeking a place to burrow. While it would seem to be impossible that they should have come down from above, it is very remarkable that they should come up from below, leaving their dark, earthy home to be pelted by the rain, which seems so disastrous to them. Besides, they are often found in situations which they could not have reached from the earth, as in tightly cemented cisterns, closed with no opening except where the water pipe enters from the roof. Have those found drowned in rain barrels committed suicide by crawling up the side of the barrel and thence into the water? By the way, who can vouch for their ability to climb a vertical surface in that way?

This morning, after a shower, I found several earth worms near the middle of a street paved with asphalt. There was no crack or crevice in the pavement, and it connected smoothly, on each side, with a curbstone six-and-a-half inches high. It would seem entirely contrary to nature for them to leave the soft earth, climb over the curbstone and make the long journey to the middle of the street.

I have no theory or explanation to offer. My relation to the subject is merely that of an interested observer. I would be glad if others would contribute their observations, with a view to arriving at the true explanation.

Charles B. Palmer.

Columbus, Ohio.

Late-Blooming Trees.

Dr. Walter Mendelson inquires in *Science* for Dec. 15, 1893, as to "cause and effects of late-blooming of fruit trees." The fruit buds of pears, peaches, apples and cherries are formed during the late summer and early autumn. If there should be warm, damp weather in the autumn, premature blossoming is frequently caused, and the result is the fruit crop of the following season is diminished in proportion, as, of course, no new buds can be formed.

This late blooming is not at all uncommon, although I do not remember having noticed any as early as September. One season in the first week of November the pear trees in the garden were quite white with blossoms, but unfortunately I cannot recall the year.

Dr. Mendelson may enjoy a very pretty bouquet in February or March by placing in water in a sunny window the fruit-bearing branches of pears, apples or cherries; in a short time they will develop their beautiful and fragrant blossoms. F. J. THOMPSON.

New Brighton, Staten Island.

A CORRECTION.

Science is so generally exact in following copy that I must have left out one important word in a recent communication. I should have said that the *early* Iroquois had no council wampum. When the Dutch came they obtained it fast enough, but it is found on no earlier sites in their territory. The later ones have furnished it in abundance.

I wish to record the occurrence of the thick-billed guillemot in this part of New York. A young one was shot on the Seneca River, at Baldwinsville, Dec. 15, 1893. It has not been reported so far inland before. Two species of cormorant have been shot on Onondaga Lake, and I heard that a pelican was recently killed there, but have not seen it. W. M. BEAUCHAMP.

Baldwinsville, N. Y., Dec. 28, 1893.

LATE-BLOOMING TREES.

TREES or shrubs if stripped of their foliage during the summer will put out new buds and new leaves and blossoms. It is a common saying with farmers that when a tree blossoms in the fall it is about to die, which is generally the case, as it mostly occurs on diseased trees. On such a tree the leaves will often turn yellow and fall off during a dry summer. The later rains will put a little new life into it, and it will often put forth buds and blossom. The same occurs if healthy trees are stripped of their foliage during the summer.

The phenomenon of "the late blossoming of trees," referred to by Dr. Walter Mendelson in *Science* of Dec. 15, 1893, was observed here. During the latter part of September and the first of October great numbers of fruit trees were in bloom, and on many green fruit set and grew; but they all occurred in the track of a severe hail storm which in August passed over a strip of country about half-a-mile in width, cutting the foliage completely from the trees. Possibly Brielle and Alpine, N. J., were in the track of that hail storm. THOMAS S. STEVENS.

Trenton, N. J., Dec. 28, 1893.

AS TO FEIGNED DEATH IN SNAKES.

WHILE on a trip to the Bad Lands in northwest Nebraska and South Dakota in the summer of 1892, collections of rattlesnakes were made. Being much interested in the recent articles on "Feigned Death in Snakes," I have the following statement to make: Whenever a freshly captured rattlesnake was introduced in the box with the former captures it usually vented its rage on them by striking and biting. No ill effects whatever ensued. Also, when teased, the snakes would bite one another. We lost no rattlesnakes whatever on the trip. We often teased the snakes before capture, and in not one instance did they show any tendency to feign death. H. H. EVERETT.

Lincoln, Neb., Dec. 27, 1893.

THE LEAST BITTERN.

LAST summer a wounded bittern, the smallest of them all, *Botaurus exilis*, came into the grounds of the New York State Fishery Commission, at this place, and as its wing was hanging down one of my men caught it and amputated the wing. It remained and fished in a swampy bit of land where the minnows are plenty, in a pool fed by tide water, and promises to winter there. Its habit of remaining motionless when I approach it slowly and in plain sight is interesting, perched on a stick, or standing in the mud with its neck drawn up close and bill pointed upward. I can go within two feet of it and walk all around it, and the bird will not betray a sign of life, even by winking. This I do several times a week, but, if I come on it suddenly, over the bank, it will utter a cry and flop into the water and wade or swim off. I am getting fond of seeing it simulate an inanimate thing.

FRED MATHER.

Cold Spring Harbor, N. Y.

BOOK-REVIEWS.

Handbook of Public Health and Demography. By EDWARD F. WILLOUGHBY, M.D., Lond. London and New York, Macmillan & Co. 509 p., 1893. $1.50.

THOUGH appearing for the first time under the present title, this is, in fact, a third edition, greatly enlarged and improved, of the "Principles of Hygiene," published in London, 1884 and 1888. To this latest edition several important chapters have been added, as, for instance, those on "Vital Statistics," "Sewage Disposal," "Unhealthy Trades," and "Sanitary Law," while some other matter entirely irrelevant to the subject in hand has been omitted. The author, as stated in his preface, has endeavored throughout so to combine scientific accuracy with the popular treatment of personal health and social problems as to render the work a clear and comprehensive manual of the principles and practice of public health, equally adapted to the purposes of the medical man, the student, the teacher and the general reader. Hygiene is treated under the general heads of "Health of the Man," "Health of the House," "Health of the City" and "Health of the People," with sub-divisions into sections on "Dietetics," "Clothing," "Exercise," "Air, Warmth and Light," "General Sanitary Arrangements," "Water Supply," "School Hygiene," "Preventable Diseases," etc. The remaining chapters include an admirable treatise on "Demography," in which many common errors, statistical and otherwise, are exposed; a chapter on "Meteorology," another on "Sanitary Law," and an appendix of tables, etc. These various subjects are discussed so thoroughly and are so comprehensive that we are provided with a most excellent book of reference in all matters pertaining to hygiene.

Particularly noteworthy are the sections on "Dietetics" and those dealing with "House Drainage and Sanitation," and also that which discusses the neglected question of "School Hygiene." We say neglected, for even in the face of modern enlightenment on these subjects many, if not most, of our school buildings continue on the same general lines of the last generation, remodelled only so far as to gain a greater seating capacity. We do not refer to the "sanitary arrangements" of the plumber; the school building is always a favorite place for costly experiments in that direction, but rather to the heating, ventilating, school desks and seats, etc. One defect which is probably the last thought of in school building, and yet the surest in its evil effects, is that of school lighting, and in treating this all-important section the author has given us the benefit of such authorities as Professors Cohn and Förster, of Breslau, the eminent oculists. How important this subject is at once comes home to one when we remember the alarming increase of weak eyes among school children, the headaches, and the so often repeated complaint that "It hurts my eyes to look at the black-board." The chapter on "Dietetics" embraces a discussion of food stuffs, the classification and uses of food, the relative values of the common foods, their proper preparation and the adulterations which they may contain. It will be seen that the subject matter is most general, and embraces practically all that is of moment in sanitary matters, while, moreover, the arrangement and treatment are most admirably suited for convenient reference. Methods of hygienic chemical analysis are given in so far as is deemed necessary, and these sections will prove particularly valuable as an aid to the interpretation of results obtained through an expert chemist.

EXCHANGES.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York]

For Sale or Exchange.—A large number of state and general government scientific reports, Smithsonian contributions and Bulletins Torrey Club, Botanical Gazette and many others. These were obtained in the purchase of a large scientific library and are duplicates. Write for what you want and offer any sum. Mexican Boundary Survey, Torrey's Botany California, Blume's Orchids of India and Japan, and Hooker's Rododendrons of the Sikkim-Himalaya are in the lot. What offers? R. Ellsworth Call, Louisville, Ky.

Skins, with full data, of Ægialites nivosa, Ereunetes occidentalis, Ammodramus beldingi, A. rostratus, Chamæa fasciata henshawi and others from California, for native or foreign skins with full data. A. W. Anthony, 2042 Albatross Street, San Diego, California.

For Sale.—An entirely new analytical balance, made by one of the most celebrated manufacturers; capacity 100 grammes, sensitive to one-twentieth a milligramme. Never been used. Regular price, $83. Will sell for $50 cash. Address, A. P. Nichols, 41 Summer Street, Haverhill, Mass.

Museum of Hamline University desires to exchange Marine Shells, preserved alcoholic material of marine zoology, or microscopic slides for zoological specimens from southern and western United States, especially for rodents in the flesh. Correspondence solicited. Address Henry L. Osborn, Biological Laboratory of Hamline University, St. Paul, Minnesota.

For Sale.—Small collection of fine first-class sets of birds' eggs; single breech-loading shotgun, gold-filled hunting-case watch and telescope. Write for list of eggs and particulars. B. S. Bowdish, Phelps, N. Y.

Wants.

Wanted.—Sachs's Text-book of Botany, 2nd English edition. Dr. Alfred C. Stokes, 527 Monmouth Street, Trenton, New Jersey.

WANTED to exchange for human bones or recent medical text-books, the following books "Metallurgy of Silver," M. Eissler, 1889; "Practical Treatise on Petroleum," by Benj. J. Crewe, 1887; "Cook's Chemical Philosophy," 1885; "Cairn's Chemical Analysis," 1880; "Wagner's Chemical Technology," by Crookes, 1886; "Fresemier's Qual. Chem. Analysis," 1879; "Elementary Treatise on Practical Chemistry and Qual. Analysis.'—Clowes, 1881; bound Vols. 1 to 12 of Dr. Lardner's "Museum of Science and Art" (very rare), 1854; back numbers of "Electrical World," beautiful specimens of Pyrite Incrustations from Cretaceous of New Jersey; Magnetis Iron Ore, Highly Polarized. Address D. T. Marshall, Metuchen, N. J.

WANTED.--Books or information on the microscopical determination of blood and hair. Also reports of cases where hair has played an important part in the identification of an individual. Address Maurice Reiker, 206 N. First Ave., Marshalltwn, Iowa.

A GEOLOGIST thoroughly conversant with the geology of the Southern States desires an engagement. Has complete knowledge of the economic geology of Iron, Coal, Lignite, as well as Clay and Kaolin. Five years' experience with Geological Surveys. Address K., 509 West Sixth Street, Austin, Texas.

WANTED.—Tuckerman's Geneva Lichenum and Carpenter on the Microscope, Wiley's Introduction to the Study of Lichens. State price and other particulars. Richard Lees, Brampton, Ont.

SOME OF THE NEW BOOKS AT LOW PRICES.

FAMOUS VOYAGERS AND EXPLORERS.—$1.50.

MRS. BOLTON has added to her *Famous* series of books another and an unusually interesting volume, "Famous Voyagers and Explorers." It is hardly comprehensive, as it gives the biographies of only a few typical explorers—Marco Polo, Columbus, Magellan, Raleigh, and the more prominent of our modern American explorers. Doubtless such names as the Cabots, Sir Humphrey Gilbert, De Soto, Cartier, Nansen and others are reserved for a second volume. Mrs. Bolton has a gift for this sort of writing, and she has here brought together a large amount of deeply interesting matter which otherwise could only be obtained by reading through a dozen or more separate volumes. The book is illustrated with several portraits.—*Boston Transcript.*

OUR GREAT WEST.—$2.50.

THE contents of the volume appeared serially in *Harper's Magazine* and *Harper's Weekly*, in which periodicals they attracted wide attention and favorable comment. Their importance fully justified their republication in a more permanent form. The book affords a more minute insight into the present condition of the West than can be found elsewhere. What it tells is the result of personal experience, fortified by information obtained from the best-informed and most reliable men in the localities under discussion, and set forth with admirable clearness and impartiality. It is a work to be read and pondered by those interested in the growth of the nation westward, and is of permanent standard value.—*Boston Gazette.*

STATESMEN.—$2.00.

IN the preparation of this work Noah Brooks has aimed to present a series of character sketches of the eminent persons selected for portraiture. The object is to place before the present generation of Americans salient points in the careers of public men whose attainments in statesmanship were the result of their own individual exertions and force of character rather than of fortunate circumstances. Therefore these brief studies are not biographies. Mr. Brooks had the good fortune of personal acquaintance with most of the statesmen of the latter part of the period illustrated by his pen, and he considers it an advantage to his readers that they may thus receive from him some of the impressions which these conspicuous personages made upon the mental vision of those who heard and saw them while they were living examples of nobility of aim and success of achievement in American statesmanship.

MEN OF BUSINESS.—$2.00.

W. O. STODDARD, who has just written a book published by the Scribners, on "Men of Business," tells how the late Senator Stanford chopped his way to the law. "He had grown tall and strong," says Mr. Stoddard, "and was a capital hand in a hay-field, behind a plough, or with an axe in the timber; but how could this help him into his chosen profession? Nevertheless it was a feat of wood-chopping which raised him to the bar. When he was eighteen years of age his father purchased a tract of woodland; wished to clear it, but had not the means to do so. At the same time he was anxious to give his son a lift. He told Leand, therefore, that he could have all he could make from the timber, if he would leave the land clelar of trees. Leland took the offer, for a new market had latterly been created for cord-wood. He had saved money enough to hire other choppers to help him, and he chopped for the law and his future career. Over 2,000 cords of wood were cut and sold to the Mohawk and Hudson River Railroad, and the net profit to the young contractor was $2,600. It had been earned by severe toil, in cold and heat, and it stood for something more than dollars.—*Brooklyn Times.*

ORTHOMETRY.—$2.00.

IN "Orthometry" Mr. R. F. Brewer has attempted a fuller treatment of the art of versification than is to be found in the popular treatises on that subject. While the preface shows a tendency to encourage verse-making, as unnecessary as it is undesirable, the work may be regarded as useful so far as it tends to cultivate an intelligent taste for good poetry. The rhyming dictionary at the end is a new feature, which will undoubtedly commend itself to those having a use for such aids. A specially interesting chapter is that on "Poetic Trifles," in which are included the various imitations of foreign verse in English. The discussion of the sonnet, too, though failing to bring out fully the spiritual nature of this difficult verse form, is more accurate than might be expected from the following sentence: "The form of the sonnet is of Italian origin, and came into use in the fifteenth [*sic*] century, towards the end of which its construction was perfected, and its utmost melodious sweetness attained in the verse of Petrarch and Dante." In the chapter on Alliteration there are several misleading statements, such as calling "Piers the Plowman" an "Old English" poem. In the bibliography one is surprised not to find Mr. F. B. Gummere's admirable "Handbook of Poetics," now in its third edition. In spite of these and other shortcomings, which can be readily corrected in a later issue, this work may be recommended as a satisfactory treatment of the mechanics of verse. A careful reading will improve the critical faculties.—*The Dial.*

Any of the above books will be sent prepaid on receipt of the publisher's price, less ten per cent.The same discount will be allowed on any new book, not a text-book.

N. D. C. HODGES, 874 Broadway, New York.